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Assessment updates for Middle Atlantic,
New England, and Georges Bank Offshore
Surf Clam, Spisula solidissima
populations, summer 1986

by

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SUMMARY

This report provides an updated status review for Middle Atlantic, Southern New England, and Georges Bank FCZ surf clam, Spisula solidissima, populations (through August 1986) based on commercial vessel logbook data and catch sampling and the results of research vessel surveys conducted by the Northeast Fisheries Center.

Landings of surf clams during 1985 increased to 72.5 million pounds of meats, up 3% from the 1984 level of 70.2 million pounds. The proportion of the total taken from the Fishery Conservation Zone (FCZ) decreased slightly for the second straight year, from 78% in 1984 to 72% in 1985. Total FCZ landings as of 25 August 1986 were 33.9 million pounds, accounting for 63 percent of the total annual quotas for the three FCZ management areas (Middle Atlantic, Southern New England, Georges Bank), taken during 65% of the calendar year. Landings from state waters (primarily New Jersey and New York) increased 30% from 1984 (15.6 million pounds) to 1985 (20.3 million pounds). Much of the 1985 increase in state landings was due to the rapid development of the nearshore fishery in Long Island Sound, New York.

Catch per unit effort (CPUE, in bushels per hour fishing) continued to increase in all Middle Atlantic assessment areas throughout 1985 and in 1986. Average CPUE over all vessel size classes increased 110% during 1984-1985, from 77 to 162 bushels per hour. CPUE off Southern New England and Georges Bank declined between 1984 and 1985, 11% and 32% respectively. Average CPUE in 1986 increased slightly off Southern New England and nearly doubled for all vessel classes on Georges Bank. Much of the acceleration in CPUE for the Middle Atlantic assessment areas was due to the decrease in the minimum size limit (to 5 inch shell length) and the continued high abundance of strong year classes in the Northern New Jersey and Delmarva regions.

Research vessel survey data for 1986 indicate continued strong 1976 and 1977 year classes off Northern New Jersey and Delmarva, respectively. However, year classes spawned since 1977 have been relatively weak in the Middle Atlantic Bight. Abundance of surf clams off New Jersey has declined as indicated by research vessel survey indices since 1982, due to the concentration of the Middle Atlantic Fishery in that area in recent years. Abundance off Delmarva and Southern Virginia-North Carolina has remained stable in the past several years. Research vessel survey data for the Middle Atlantic region indicate adequate surf clam resources in that region to support the Middle Atlantic FCZ fishery at or near current levels (40-50 million pounds of meats per year) until the mid-1990's.

Resources off Southern New England and Georges Bank comprised 5% and 14% respectively of the entire region-wide resource in the August 1986 NEFC surf clam survey. Current annual quotas in both areas (3.4 and 5.1 million pounds respectively) will result in relatively stable stock biomass between 1986-1987. Adequate resources exist in both areas to sustain these quota levels into the 1990's.

INTRODUCTION

This document presents an updated assessment of Middle Atlantic, Southern New England, and Georges Bank FCZ (Fishery Conservation Zone) surf clam populations, currently regulated under Amendment #6 of the Surf Clam and Ocean Quohog Fishery Management Plan (Mid-Atlantic Fishery Management Council 1985). Data from research vessel surveys, logbook submissions from commercial vessels, and fishery interview records collected by NMFS port agents are updated through the third quarter of 1986. The report reviews trends in abundance, size distribution, landings, discard of small clams during fishing operations, and commercial catch rates (CPUE by vessel size class and area) and presents a forecast of stock status for the next several years given the current regulatory program. Results and conclusions augment and expand upon those presented in previous assessment reports (Brown et al. 1977, Serchuk et al. 1978, Murawski and Serchuk 1979, Serchuk and Murawski 1980, Murawski and Serchuk 1981, 1982, 1983, 1984a, 1984b, 1984c).

COMMERCIAL FISHERY

Total surf clam landings in 1985 were 72.5 million pounds of meats, an increase of 3% over the 1984 total of 70.2 million pounds (Table 1, Figure 1). FCZ surf clam landings decreased 4% between 1982 and 1983, from 54.6 to 52.2 million pounds. Total FCZ landings (from the Mid-Atlantic, New England, and Georges Bank Management areas) as of 25 August 1986 were 33.9 million pounds, of which 28.5 million pounds (84%) was from the Middle Atlantic Management area, and 5.4 million pounds (16%) from the Southern New England and Georges Bank areas. The 1986 year to date (YTD) surf clam landings as of 25 August were about 63% of the combined annual quotas taken in 65% of the calendar year. The largest proportion of Middle Atlantic area landings during 1985 were derived from the Northern New Jersey (NNJ) assessment area (50%), followed by the Delmarva (DMV) area (40%), and the remainder off Southern New Jersey (SNJ, 6%), and Southern Virginia-North Carolina (SVA-NC; 4%; Table 2; Figure 2). YTD 1986 landings for the Middle Atlantic management area were concentrated off Northern New Jersey (68%), followed by Delmarva (21%), Southern New Jersey (8%), and Southern Virginia-North Carolina (3%; Appendices 1-4). The concentration of Middle Atlantic landings off NNJ in 1986 is primarily related to the fact that the largest proportion of legal sized clams (> 5 inches, shell length) is located off Northern New Jersey (see 'RESULTS OF RESEARCH VESSEL SURVEYS').

Catch and Effort Trends

Data on catch, fishing effort, and catch per unit effort (CPUE) for the four Middle Atlantic assessment areas, and for the Southern New England and Georges Bank management areas are presented in Table 2 and Appendices 1-6. These data were derived from mandatory logbook submissions which are a condition of participation in the FCZ fishery.

Effort

Total numbers of vessel trips in the Middle Atlantic area (all vessel size classes combined) declined 20% between 1984 and 1985 -- from 2,837 trips in 1984 to 2,278 trips in 1985. Total vessel trips in the first two quarters of 1986 were 1,086 for the Middle Atlantic management area (Appendices 1-4). During the first two quarters of 1985 there were 1,431 vessel trips in the same region. Thus, a decline of 24% in vessel trips was exhibited during the first quarter of 1986. Total vessel trips in the Southern New England area remained relatively stable during 1984-1985, increasing 3% (Table 2; Appendix 5). Total Southern New England trips YTD in 1986 (Appendix 5) are 86, thus it is likely that the annual total for 1986 will increase to more than in 1984-1985. Georges Bank trips increased 9% between 1984-1985 (Table 2), but are significantly reduced YTD in 1986. Whereas 127 vessel trips were taken on Georges Bank during the second quarter of 1985, only 60 trips were landed from Georges Bank during the second quarter of 1986 (Appendix 6).

Catch

Total catch from the Middle Atlantic assessment area decreased slightly (2%) between 1984-1985, primarily due to a fishery closure during the last several weeks of 1985, resulting in a small amount of quota not being harvested. YTD catches for the Middle Atlantic assessment area are approximately on an annual schedule to achieve the Mid-Atlantic quota of 45 million pounds of meats. Total landings increased 14% in the Delmarva assessment area between 1984-1985, primarily due to an 18% increase in class 3 vessel catch during that period. Increases in the Delmarva area during 1985 were probably associated with the initial decrease in the minimum size regulation from 5 1/2 inches to 5 1/4 inches shell length. However, since discard rates were generally higher there, notwithstanding the declines in minimum size, the fleet has since concentrated off Northern New Jersey.

Southern New England landings increased 22% between 1984-1985, whereas Georges Bank landings declined, primarily due to a reduction in the allowable catch from 6.8 million pounds in 1984 to 5.1 million pounds in 1985-86 (Murawski and Serchuk 1984b.).

CPUE

Quarterly trends in CPUE by vessel size class and assessment area are illustrated in Figures 3-8. Average CPUE for all vessel size classes in the Middle Atlantic region increased 110% from 77 to 162 bushels/hour. Average CPUE values for all vessel classes in every Middle Atlantic area increased between 1984-1985 (Table 2). CPUE of vessel classes 1 (1-50 GRT), 2 (51-100 GRT), and 3 (101 + GRT) increased 67, 71, and 74%, respectively off NNJ; 134, 80, and 110% SNJ; 102, 160, and 155% off DMV; and 163, and 167% for vessel classes 2 and 3 off SVA-NC. During 1986 average CPUE continued to increase for most vessel classes in each area.

Quarterly CPUE generally sequentially increased in NNJ from 1982 through 1986 (Figure 3; Appendix 1). During 1980-1982 CPUE peaked off NNJ, prior to the implementation of a minimum size regulation (5 1/2 inches shell length, July

1981). Thereafter, CPUE declined until 1982 as compliance with the minimum size regulation increased. Growth in biomass of the strong 1976 year class off NNJ combined with reductions in the minimum size regulation (to 5 1/4 inches in October 1984, and to 5 inches in November 1985), have contributed greatly to the increased CPUE off NNJ during recent years. In particular, the size reductions have had a dramatic effect in accelerating CPUE during 1984-1986.

CPUE for the SNJ assessment area has generally increased in each quarter since early 1983 (Figure 4; Appendix 2). Although the 1976 year class is primarily concentrated in the NNJ assessment area, some of this cohort exists at the northern extent of the SNJ boundary (primarily on 'Five Fathom Bank') and is contributing to the increased catch rates in the area. However, the overall representation of the 1976 year class in the SNJ area is relatively small (see "Research Vessel Surveys").

Delmarva CPUE values have increased since late 1982 for vessel classes 2 and 3; class 1 CPUE values have also increased but not as systematically as the other vessel classes. The nearly four fold and six fold increases in CPUE for class 2 and 3 vessels respectively since 1983 is apparently due to a greater utilization of the strong 1977 year class off Delmarva (see "Research Vessel Surveys"). This conclusion is supported by a decline in mean size of clams sampled off Delmarva (Table 3), and substantial reductions in discard of small clams from the region (Figure 9). CPUE values for vessel classes 2 and 3 operating off SVA-NC have also increased during 1983-1986 (Figure 6; Appendix 4). However, the quantity of landing derived from that area decreased significantly during 1984 and again in 1985 (Table 2).

CPUE for the Southern New England and Georges Bank management areas fluctuated considerably during 1984-1986 (Figures 7 and 8; Appendices 5 and 6). CPUE is generally the lowest for all areas and vessel classes in the SNE assessment area. Georges Bank CPUE for class 3 vessels was 134 bushels/hour in 1984, declining to 88 bushels/hour in 1985, and has increased to 157 bushels/hour during 1986. Changes in CPUE for Georges Bank are indicative of the exploratory nature of this fishery, and that a consistent fleet of vessels has not worked in that area during 1984-1986. Increases in CPUE during 1986 are thought to be primarily related to the entrance of several very large class 3 vessels as compared to other vessels fishing on Georges Bank. Considerable variability in the location of fishing areas on Georges Bank has also contributed to fluctuating CPUE there during 1984-1986.

Size Composition of Landings

Shell size composition of FCZ surf clam landings is routinely monitored by National Marine Fisheries Service (NMFS) port agents. Major Middle Atlantic surf clam ports sampled are Atlantic City and Cape May-Wildwood, New Jersey, Ocean City, Maryland, and Chincoteague, Virginia. Surf clam landings from the Southern New England and Georges Bank assessment areas are sampled primarily at the ports of Provincetown and New Bedford, Massachusetts, and Point Judith, Rhode Island.

Numbers of clams measured in each area and calendar quarter as well as mean clam sizes and percentages of clams above/below 140 mm (5 1/2 inches) shell size are presented in Tables 3 and 4. Average shell size and the percentage of clams greater than 140 mm decreased in all Middle Atlantic assessment areas

between 1983 and 1986. This decrease is most apparent off Delmarva where mean shell size has declined from an average of 148 mm during 1983 to 131 mm in 1986. Concurrently, the proportion of clams landed less than 140 mm increased from 35% in 1983 to 88% in 1986. Lesser declines in average size and percent of clams greater than 140 mm are notable for the NNJ area. Data for SNJ also document the trend to smaller average sizes in recent years. Information for SVA-NC are insufficient to analyze trends in size composition of landings. The primary reason for the dramatic reduction in the size compositions of landings are the regulatory amendments to the minimum size, reducing the minimum legal size from 5 1/2 to 5 1/4" (140 to 133 mm) in October 1984, and 5 1/4 to 5" (133 to 127 mm) in November 1985.

Size composition data for the Southern New England and Georges Bank fisheries are given in Table 4. Most apparent in these data are the declines in the mean length of landings from Georges Bank during 1984-1986, and that the Southern New England area generally yields larger clams than any of the other Middle Atlantic assessment areas, or Georges Bank.

Discarding of Small Surf Clams

Data on discarding of small surf clams have been acquired since the first quarter of 1982 during routine port agent interviews (Murawski and Serchuk 1984b.) in the Middle Atlantic assessment area. Vessel captains are requested to estimate the quantity (bushels) or percentage (in terms of landings) of small clams discarded at sea. Individual estimates are then combined, weighting by each vessel's landings, to derive fleet averages of discard percentages.

Discard percentages peaked during the fourth quarter of 1982 for both the New Jersey and Delmarva area (Figure 9). Discard rates off New Jersey declined from 52% of landings during the last quarter of 1982 to less than 20% during the last quarter of 1983. The percentage of discard increased slightly during the first quarter of 1984 off New Jersey (to 27%), but has since declined sharply. Similarly, discard percentages for Delmarva peaked during the last quarter of 1982 (47%), declined to 25% during the first quarter of 1983 and then fluctuated between 20 and 40% until the last quarter of 1984. Discard rates during 1986 for both New Jersey and Delmarva areas averaged 16% for those vessels reporting discard information.

No discard has been reported for the Southern New England or Georges Bank assessment areas, consistent with the generally large-sized clams landed from those areas (Table 4).

RESULTS OF RESEARCH VESSEL SURVEYS

A series of 17 research vessel survey cruises have been conducted between 1965 and 1986 to evaluate the distribution, relative abundance, and size structure of surf clam and ocean quahog populations in the Middle Atlantic region (Table 5). Information from these surveys is used to predict relative year-class strength, and to evaluate harvest levels given goals established by fishery managers. Assessments of both short- and long-term fishery productivity are based on correlating trends in survey abundance indices with fishery

yields. The surveys are performed using a stratified random sampling design, allocating a predetermined number of survey stations (tows) to each subarea (stratum) sampled (Figure 2, Table 6). At each station, a 5-minute survey tow is made with a 1.5-meter (60-inch) wide hydraulic clam dredge. Survey catches are enumerated and a subsample measured to estimate the size distribution of the catch at each station. The meat weight of clams caught at each station is computed utilizing length-weight equations (Murawski and Serchuk 1981, 1982). Mean number and weight per tow and number per tow at each 10-mm length interval are computed for each stratum. Survey data from the various strata are combined to form seven groups which generally overlap assessment areas used in summarizing logbook and interview data (Figure 2 of Murawski and Serchuk 1984b.). Abundance indices and size distributions of clams are separately calculated for each assessment area to monitor the dynamics of surf clam populations within each region (Tables 7-10, Figures 10-14).

Catch per tow data for the Middle Atlantic survey time series are presented in Table 7-10. Included are percentages of the catch (in numbers and weights) above 140 mm shell length ($5\frac{1}{2}$ '). Survey length frequency distributions for Northern New Jersey, Southern New Jersey, and Delmarva, 1976-1986, are given in Figures 9-11. Survey size compositions for Southern New England and Georges Bank are given in Figures 13-14. The size distribution of clam resources in the six assessment areas is also illustrated in Figures 15-16, and is given in Table 11. Data are presented for five different size categories ($0-4\frac{3}{4}$ ", $4\frac{3}{4}-5$ ", $5-5\frac{1}{4}$ ', $5\frac{1}{4}-5\frac{1}{2}$ ', $>5\frac{1}{2}$ '). Survey catch data are described for each assessment area individually.

Northern New Jersey

Stratified mean number-per-tow indices declined steadily between 1976 and April 1976, and more rapidly between 1976 and 1977 (Table 7). From 1965 to April 1976 total numbers declined 65% while clams $5\frac{1}{2}$ ' or greater dropped in abundance by 60%, and those less than $5\frac{1}{2}$ ' by 78%. The proportion of total numbers per tow comprised of class $>5\frac{1}{2}$ ' increased from 71% in 1965 to 82% in 1976, indicative of poor recruitment during this period. Biomass indices of clams $<5\frac{1}{2}$ ' declined 86% during this period. Primarily as a result of the hypoxic water event off the New Jersey coast during 1976, the total number per tow index declined 81% between 1976 and 1977; total biomass, 89%. Numbers and weight per tow further declined from 1977 to January 1978. The December 1978 survey, however, revealed significant new recruitment. Subsequent age and growth analyses indicate that these clams were spawned in 1976. Surveys conducted after 1978 have confirmed the presence of this cohort and provide data to track growth rate of this year class (Figure 10). Total mean number per tow increased from 2.1 during the January 1978 survey to 44.9 in December 1978. In seven subsequent surveys, total numbers per tow have averaged 60.1. Total numbers and weight per tow indices declined from 1984 to 1986 (30 and 16%, respectively, for numbers and weight). Total number per tow indices have declined in the three surveys conducted since 1982 (1983, 1984, 1986). Number per tow indices for clams $>5\frac{1}{2}$ ' have remained relatively stable during 1982-1986, with the 1986 value (14.76) the highest since the June 1974 survey. Total weight per tow indices for NNJ have similarly declined since 1982, reflecting the intensive fishery concentrating on the NNJ region (see "COMMERCIAL FISHERY"). Pre-recruit indices for the NNJ area continue to decline, reflecting the virtual single year class (1976) nature of the NNJ

resource (Table 7; Figure 10). Based on 1986 survey results 21.2% of the total region-wide FCZ surf clam biomass exists in the NNJ region, and the NNJ surf clam biomass is comprised primarily by clams $>5"$ (61.1%; Table 11; Figure 16). In terms of numbers of clams, the NNJ resource comprises 16.5% of the total among all regions and 77.2% of the clams off NNJJ are $>5"$ (Table 11; Figure 15).

Survey results for NNJ during 1984 indicated some 1983 year class clams in that region. Since these clams were only partially recruited to the survey gear in 1984, a definitive evaluation of cohort strength was not possible. Results of the 1986 survey, however, did not reveal considerable numbers of clams in the 7-9 cm shell length range (Figure 10), and thus the 1983 cohort off NNJ is thought to be relatively weak. Thus, no cohorts off NNJ spawned subsequent to the 1976 year class are considered likely to be able to support significant fishing activity in the future. Thus, the NNJ fishery will be dependent on the 1976 cohort until at least 1992.

Southern New Jersey

Total stratified mean number and weight per tow indices for the Southern New Jersey assessment area declined from 1965-1970, increased in 1974, and subsequently dropped to the lowest observed values in 1977 (Table 8). Since 1980 total indices have stabilized, but at a level considerably below that observed during the mid- to late 1960's. The 1982-1986 number per tow indices averaged 15.4, 81% less than the 1965-1969 mean (79.5). Similarly, weight per tow values for 1982-1986 averaged 1.7 kg, 72% less than 1965-1969 (9.6 kg). The highest prerecruit index for the Southern New Jersey area occurred in 1965. Although slight improvement in prerecruit abundance was observed in the 1978-1980 surveys, the average number per tow of $<5\frac{1}{2}"$ surf clams off SNJ during December 1978-1980 surveys (3.3) was 8% of the comparable average off NNJ (40.7). The number per tow index for clams $<5\frac{1}{2}"$ for the 1986 survey was the highest since December 1978, with prerecruit clams primarily in the 7-9 cm size range (Figure 11). Total weight per tow in the SNJ area during 1986 (3.17 kg/tow) was the highest since June 1974. Based on 1986 survey results, the SNJ assessment area contains about 2.5% of the total resource in numbers, and 5.3% in biomass of meat (Table 11). The SNJ resource is dominated by clams $>5\frac{1}{2}$ inches shell length (77.4% in numbers; 94% in meat weight; Table 11; Figures 15-16).

Delmarva

Total number per tow indices for the Delmarva resource were relatively stable between 1965 and 1976, but declined by 47% between the April 1976 and January 1978 surveys (Table 9, Figure 12). Total catch per tow values (in numbers) in the last eight surveys (1978-1986), however, have been the largest observed in the time series. Relatively pronounced variations in prerecruit catch per tow indices since December 1978 generally reflect a few survey tows yielding extremely large numbers of young clams (primarily in strata 85 and 9). Abundance indices of exploitable sized clams have not exhibited such variability. As in northern New Jersey, the relatively high prerecruit indices in Delmarva primarily reflect the successful settlement of a single year class, in this case, the 1977 cohort.

The 1984 Delmarva number per tow index declined 19% from the 1984 value; total weight per tow however increased 30%, reflecting the larger average size of clams in the recent survey (Figure 12). Number per tow indices for the Delmarva area increased only slightly (1%) from the 1984 survey, indicative of the slow rate of growth exhibited by this resource. Currently, the Delmarva resource accounts for 56.2% of total numbers and 50% of surf clam biomass surveyed in 1986. Nevertheless, 55.3% of the Delmarva resource weight and 67.6% in numbers is currently below the 5 inch minimum shell size (Table 11; Figures 15-16).

Southern Virginia - North Carolina

Stratified mean number per tow indices for the Southern Virginia - North Carolina area are available from 14 surveys between 1965-1986 (Table 10). Weight per tow values and size frequency distributions were not computed for cruises prior to 1983 due to the inadequate sampling coverage.

Total number and weight per tow indices for the SVA-NC area decreased 10.3 and 13.6% respectively between 1984 and 1986 surveys. Given the variability exhibited in SVA-NC abundance indices, these declines are probably not reflective of significant downward trends in clam stock size. Unlike the Delmarva assessment area, the SVA-NC area is comprised of primarily legal-sized clams, with only 14.9% of the resource in weight and 19.0% in numbers under 5 inches shell length. The SVA-NC area accounts for 4.9% (numbers) and 4.3% (weight) of the FCZ resource evaluated during the 1986 NEFC ocean clam survey (Table 11; Figures 15-16).

Long Island

Although the Long Island, New York FCZ surf clam resource supports only very limited surf clam harvesting, clams are caught in this region as part of the combined surf clam-ocean quahog survey. The offshore Long Island area is part of the Middle Atlantic Management area defined for surf clams. This area accounts for less than 1% of the FCZ surf clam resource in numbers and biomass (Table 11; Figures 15-16). The Long Island resource is dominated by clams >5 1/2 inches (66.5% in numbers, 87.1% in meat weight).

Southern New England

Survey abundance data for the Southern New England area are reviewed in Murawski and Serchuk (1983) and in Table 11 and Figures 15-16. Based on results of the 1986 NEFC survey, the SNE surf clam resource comprises 2.8% of the region-wide total in numbers and 4.7% in weight. These percentages are roughly half the percentages estimated in Murawski and Serchuk (1983). The stratified mean number per tow index from the 1980-1982 surveys off SNE was 13.57; the corresponding weight per tow index was 2.00 kg/tow. Based on these indices Murawski and Serchuk (1983) concluded that the SNE resource was 4.6% of the Middle Atlantic-Southern New England total in weight and 10.05 in numbers. These calculations did not include Georges Bank surf clam resources in an estimate of total FCZ resources. The 1986 abundance indices in numbers

Abundance of surf clams in the Northern New Jersey area is apparently declining in response to the concentration of the Middle Atlantic FCZ fishery in that region. These declines will likely continue in the next several years, since the NNJ region is dominated by legal-sized (>5 inch) clams, and thus the fishery can land large vessel trips with minimal discarding. Clam abundance off Delmarva remained relatively stable during 1984-1986, as the fishery shifted primarily to Northern New Jersey waters. The preponderance of DMV surf clam resource continues to be below the 5 inch minimum size, and thus it is unlikely that significant shifts in the fishery to the Delmarva region will occur during 1986-1987.

Southern New Jersey surf clam populations are generally dominated by relatively large surf clams, although recent landings from that area have occurred primarily on 'Five-Fathom Bank,' an area containing relatively small clams.

Pre-recruit indices for all Middle Atlantic assessment areas in 1986 did not indicate the presence of relatively strong year classes spawned after 1977. Thus, current known resources will support all Middle Atlantic surf clam fishing until at least 1992. If a strong year class was produced in 1986, it would take 6-7 years for portions of that cohort to reach the minimum legal size. Harvestable biomass of the Middle Atlantic resource remains high relative to earlier years (Tables 9-12) and thus current harvest levels (40-50 million pounds of meats per year) should be able to be sustained by the resource well into the 1990's.

Stock biomass off Southern New England apparently decreased during 1982-1986, based on NEFC research surveys. CPUE indices are generally lowest in the SNE assessment region as compared to the Middle Atlantic and Georges Bank regions. The SNE resource is comprised primarily of relatively large surf clams, prerecruit indices for the area are generally low, although the 1986 survey revealed increased numbers of 5-8 cm clams. Current harvest levels (3-4 million pounds per year) can probably be sustained during the next several years, although biomass is apparently declining and is likely to continue to do so in the near future.

The Georges Bank resource currently accounts for about 13.5% of the region-wide biomass, and is comprised of a considerable quantity of clams <5" shell length. Although abundance of large surf clams may have declined between 1984-1986 (primarily due to intensive fishing in the Cultivator Shoals region where relatively large clams were caught during 1984-1985), there is apparently adequate stock biomass of harvestable clams in that region (Figure 14) to sustain the fishery at or near current harvest levels (5.1-6.8 million pounds) for the next few years. The decline in Georges Bank CPUE during 1984-1985 probably reflected decreased resource abundance in the Cultivator Shoals region during the initial phases of this fishery. Because of the essentially exploratory nature of this fishery, CPUE is likely to fluctuate considerably as new resources are brought into production and the size composition of the fleet changes. This is reflected in CPUE values for 1986, when several very large class 3 vessels participated for the first time in the Georges Bank fishery. Changes in Georges Bank CPUE are also related to the seasonal nature of Georges Bank fishing, as the primary activity in that region is conducted in spring and summer, with little activity during winter months (Appendix 6).

(6.33) and weight (0.84) were 53 and 58% lower respectively than corresponding data from combined 1980-1982 surveys. SNE surf clam resources continue to be dominated by relatively large sizes (Figure 13), with modal clam size in the 1986 survey at 15 cm shell length. The modal size for 1980-1982 surveys was 16 cm. Unlike earlier surveys, however, some relatively small (5-8 cm) clams were encountered in SNE during the 1986 survey (Figure 13).

Georges Bank

Research vessel survey data for the Georges Bank assessment area are given in Table 11 and Figures 14, 15 and 16. Survey abundance indices for Georges Bank increased from 1984 values (Figure 14), primarily due to increased catches of small (3-13 cm) individuals. Total number per tow increased from 8.07 in 1984 to 16.88 in 1986 (+233%). However, abundance indices for clams >14 cm decreased between 1984-1986 (Murawski and Serchuk 1984c.). These data are not necessarily indicative of large increases in prerecruit resource abundance since they compare only two point estimates, and do not rely on time series data. Particularly for Georges Bank, where survey techniques and analysis methods must take into account the difficulty of surveying and the large amount of non-fishable bottom, caution should be used in interpreting the results of a single survey.

Based on 1986 survey data (Table 11), 16.5% of total FCZ surf clam numbers, and 13.5% of resource weight occur in the Georges Bank survey area. The Georges Bank resource is dominated by relatively small individuals: 47.1% of the biomass and 70.1% of the resource in numbers are below 5 inches shell length.

CURRENT STATUS AND PROJECTED FISHERY IMPACTS

Commercial catch rates (CPUE) in the Middle Atlantic FCZ surf clams fishery continued to increase sharply during 1985-1986. These increases in Middle Atlantic CPUE are partially due to continued recruitment of the strong 1976 and 1977 year classes to the fishery, but more importantly the reductions in minimum clam size from 5 1/2 to 5 1/4 inches in 1984, and from 5 1/4 to 5 inches in late 1985. Acceleration in CPUE during 1984-1986 has resulted in the available fishing time per vessel being reduced to 6 hours every two weeks for most of 1985 and all of 1986. Nevertheless, several short-term fishery closures have been required to prevent total harvest from exceeding Middle Atlantic quotas.

Decreases in the minimum clam size have had the beneficial effect of reducing surf clam discard in the Middle Atlantic fishery. Data for 1986 indicate an average discard rate equivalent to 16% of landings for New Jersey and Delmarva waters combined. This value may be somewhat of an under estimate of the actual discarding rate, as a higher proportion of vessels are either not reporting discard data or reporting zero discard than in 1983-1985. Current discards are, then, well below the Mid-Atlantic Council's target of 30% of landings. Reductions in minimum size will also likely increase total cohort yields, as a slight gain in yield per recruit results from decreasing the minimum size from 5 1/2 to 5 inches (Murawski and Serchuk 1982).

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Table 1. Total USA surf clam landings (thousands of pounds of meats), total landings from the Fishery Conservation Zone (FCZ), landings from state waters, and percent of total from the FCZ.

Year	Total Landings	FCZ Landings	State Waters Landings	Percent Landed ¹ from FCZ
1965	44,088	33,000	11,088	75
1966	45,113	32,400	12,713	72
1967	40,054	24,700	15,354	55
1968	40,552	20,000	20,552	49
1969	49,575	15,900	33,675	32
1970	67,318	14,100	53,218	21
1971	52,535	50,053	2,482	95
1972	63,371	55,272	8,099	87
1973	82,370	72,579	9,791	88
1974	96,110	74,430	21,680	77
1975	86,956	44,270	42,686	51
1976	49,113	42,558	6,575	87
1977	51,036	42,968	8,068	84
1978	39,237	31,393	7,844	80
1979	34,912	29,070	5,842	83
1980	37,737	34,718	3,019	92
1981	46,100	37,361	8,739	81
1982	49,720	36,792	12,948	74
1983	55,938	45,163	10,775	81
1984	70,243	54,621	15,622	78
1985	72,520	52,229	20,291	72
1986 ²		33,873		

¹Prorations for 1971-1985 based on data presented in "Fisheries of the United States". Earlier data are based on interviews conducted by the U.S. Bureau of Commercial Fisheries, Oxford Laboratory.

²Total FCZ landings through 25 August 1986. Of this total 28,482 pounds were landed from the Middle Atlantic area and 5,391 pounds were landed from New England - Georges Bank.

Table 2. Comparison of Mid-Atlantic, New England, and Georges Bank surf clam fishery catch and effort statistics by area and vessel size class, 1985 vs 1984. Data are from vessel trip logbooks.

Area	Vessel Class	1985				1984				Percentage Change 1985 vs. 1984			
		Trips	Landings (100's bu)	Hours Fished	Mean Bushels/hr	Trips	Landings (100's bu)	Hours Fished	Mean Bushels/hr	Trips	Landings	Hours Fished	Mean Bushels/hr
<u>Northern New Jersey</u>													
	Class 1	107	478	620	77	102	466	1023	46	+5	+3	-39	+67
	2	769	5434	4386	124	1009	6651	9286	72	-24	-18	-53	+72
	3	525	4761	2979	160	435	3720	4051	92	+21	+28	-26	+74
	Total	1401	10673	7985	134	1546	10837	14360	75	-9	-2	-44	+79
<u>Southern New Jersey</u>													
	Class 1	12	54	72	75	77	237	752	32	-84	-77	-90	+134
	2	21	106	118	90	93	465	929	50	-77	-77	-87	+80
	3	110	1034	630	164	172	1365	1745	78	-36	-24	-64	+110
	Total	143	1194	820	146	342	2067	3426	60	-58	-42	-76	+143
<u>Delmarva</u>													
	Class 1	53	259	286	91	63	314	692	45	-16	-18	-59	+102
	2	83	750	480	156	116	793	1325	60	-28	-5	-64	+160
	3	538	7569	3157	240	643	6397	6827	94	-16	+18	-54	+155
	Total	674	8578	3923	219	822	7504	8844	85	-18	+14	-56	+158
<u>So. Virginia-North Carolina</u>													
	Class 1	1	2	5	40	-	-	-	-	-	-	-	-
	2	13	111	74	150	29	197	348	57	-55	-44	-79	+163
	3	46	673	260	259	98	1074	1112	97	-53	-37	-77	+167
	Total	60	786	339	232	127	1271	1460	87	-53	-38	-77	+167
<u>Total Mid-Atlantic</u>													
	Class 1	173	793	983	81	242	1017	2467	41	-29	-22	-60	+98
	2	886	6401	5058	127	1247	8106	11888	68	-29	-21	-57	+87
	3	1219	14037	7026	200	1348	12556	13735	91	-10	+12	-49	+120
	Grand Total	2278	21231	13067	162	2837	21679	28090	77	-20	-2	-53	+110
<u>Southern New England</u>													
	Class 1	2	2	15	13	7	15	154	10	-71	-87	-90	+30
	2	24	132	547	24	70	364	1131	32	-66	-64	-52	-25
	3	79	640	1698	38	25	253	380	67	+216	+153	+347	-43
	Total	105	774	2260	34	102	632	1665	38	+3	+22	+36	-11
<u>Georges Bank</u>													
	Class 1	-	-	-	-	-	-	-	-	-	-	-	-
	2	20	155	225	69	15	137	238	58	+33	+13	-5	+19
	3	190	2617	2987	88	178	2764	2063	134	+7	-5	+45	-34
	Total	210	2772	3212	86	193	2901	2301	126	+9	-4	+40	-32

Table 3. Sampling of surf clam shell lengths from commercial catches in four Middle Atlantic assessment areas, 1976-1984.
Northern New Jersey is NNJ, Southern New Jersey is SNJ, Delmarva is DMV, and Southern Virginia-North Carolina is SVNC.

Year	Quarter	Number of Clams Measured				Mean Shell Length (mm)				Percent of Clams <140 mm				Percent of Clams ≥140 mm			
		NNJ	SNJ	DMV	SVNC	NNJ	SNJ	DMV	SVNC	NNJ	SNJ	DMV	SVNC	NNJ	SNJ	DMV	SVNC
1976	1	0	0	160	10	-	-	158	153	-	-	11.9	10.0	-	-	88.1	90.0
	2	0	0	200	10	-	-	162	162	-	-	7.0	0.0	-	-	93.0	100.0
	3	40	40	270	30	158	169	160	152	5.0	0.0	7.4	16.7	95.0	100.0	92.6	83.3
	4	0	0	0	0	-	-	- ²	- ²	- ²	- ²	- ²	- ²	-	-	-	-
	Σ	40	40	630	50	158	169	160	154	5.0	0.0	8.4	12.0	95.0	100.0	91.6	88.0
1977	1	0	0	0	0	-	-	-	-	0.0	-	-	-	100.0	-	-	-
	2	20	0	0	0	161	-	-	-	-	-	-	-	-	-	-	-
	3	120	270	1,881	0	173	171	164	-	0.0	0.1	6.5	-	100.0	100.0	93.5	-
	4	180	55	1,399	0	176	178	165	-	0.0	0.0	4.5	-	100.0	99.9	95.5	-
	Σ	320	325	3,280	0	174	173	164	-	0.0	0.1	5.6	-	100.0	100.0	94.4	-
1978	1	0	119	779	0	-	175	161	-	-	0.0	11.5	-	-	100.0	88.5	-
	2	600	210	3,182	0	166	173	159	-	2.8	0.1	9.2	-	97.2	99.9	90.8	-
	3	330	0	2,999	0	170	-	160	-	0.0	-	10.3	-	100.0	-	89.7	-
	4	0	0	1,933	0	-	-	160	-	-	-	12.7	-	-	-	87.3	-
	Σ	930	329	8,893	0	166	173	160	-	1.4	0.1	10.6	-	98.6	99.9	89.4	-
1979	1	0	30	2,098	0	-	166	158	-	-	6.7	21.7	-	-	93.3	78.3	-
	2	0	0	2,384	0	-	-	150	-	-	-	28.4	-	-	-	71.6	-
	3	30	390	2,188	0	165	167	155	-	13.3	6.7	19.7	-	86.7	93.3	80.3	-
	4	0	30	1,687	0	-	176	160	-	-	0.0	15.2	-	-	100.0	84.8	-
	Σ	30	450	8,357	0	165	169	155	-	13.3	5.0	21.4	-	86.7	95.0	78.6	-
1980	1	0	0	1,333	0	-	-	160	-	-	-	16.3	-	-	-	83.7	-
	2	0	60	2,381	0	-	154	155	-	-	23.3	19.2	-	-	76.7	80.8	-
	3	60	210	1,942	0	106	165	156	-	100.0	11.3	16.1	-	0.0	88.7	83.9	-
	4	0	0	441	0	-	-	136	-	-	-	65.1	-	-	-	34.9	-
	Σ	60	270	6,097	0	106	159	151	-	100.0	18.1	27.9	-	0.0	81.9	72.1	-
1981	1	540	30	2,134	0	175	159	144	-	1.2	13.3	43.1	-	98.8	86.7	56.9	-
	2	369	30	2,528	0	149	168	140	-	38.3	3.3	52.6	-	61.7	96.7	47.4	-
	3	1,169	60	994	0	154	156	147	-	10.5	9.1	35.8	-	89.5	89.9	64.2	-
	4	690	30	692	0	151	157	133	-	16.6	6.7	50.9	-	83.4	93.3	49.1	-
	Σ	2,768	150	6,348	0	157	160	142	-	17.8	9.9	47.0	-	82.2	90.1	53.0	-
1982	1	270	60	1,681	0	147	163	161	-	36.2	1.3	6.3	-	63.8	98.7	93.7	-
	2	958	30	2,024	0	157	165	159	-	4.2	3.3	9.6	-	95.8	96.7	90.4	-
	3	1,500	360	2,108	90	152	171	155	150	8.5	1.6	18.3	16.3	91.5	98.4	81.7	83.7
	4	2,640	182	1,550	642	147	167	158	142	20.2	2.8	13.4	52.3	79.8	97.2	86.6	47.7
	Σ	5,368	632	7,363	732	151	168	158	144	18.3	2.3	11.8	45.2	81.7	97.7	88.2	54.8
1983	1	2,576	362	2,219	0	146	158	161	-	26.6	18.2	5.7	-	73.4	81.8	94.3	-
	2	1,568	60	1,170	300	145	159	143	143	31.3	3.3	34.0	36.9	68.7	96.7	66.0	63.1
	3	1,680	120	1,570	120	147	170	147	144	18.8	10.4	31.3	27.7	81.2	89.6	68.7	72.3
	4	2,549	0	724	0	146	-	140	-	23.0	-	53.9	-	77.0	-	46.1	-
	Σ	8,373	542	5,483	420	146	168	148	143	24.5	10.1	34.6	32.9	75.5	89.9	65.4	67.1
1984	1	3,931	0	1,190	0	145	-	139	-	25.3	-	57.0	-	74.7	-	43.0	-
	2	2,400	0	756	0	145	-	139	-	27.1	-	57.8	-	72.9	-	42.2	-
	3	1,710	0	450	30	144	-	139	137	32.0	-	56.0	60.0	68.0	-	44.0	40.0
	4	2,190	60	502	-	140	134	134	-	47.4	73.3	74.8	-	52.6	26.7	25.2	-
	Σ	10,231	60	2,898	30	143	134	138	137	32.5	73.3	61.5	60.0	67.5	26.7	38.5	40.0
1985	1	3,900	90	720	-	141	130	134	-	44.2	83.7	75.8	-	55.8	16.3	24.2	-
	2	2,730	-	953	-	142	-	132	-	41.5	-	87.1	-	58.5	-	12.9	-
	3	2,550	390	510	-	140	124	132	-	50.8	92.8	86.1	-	49.2	7.2	13.9	-
	4	1,590	210	606	-	139	130	134	-	57.6	89.5	80.0	-	42.4	10.5	20.0	-
	Σ	10,770	690	2,789	-	141	127	133	-	47.1	90.6	82.5	-	52.9	9.4	17.5	-
1986	1	1,770	450	270	42	136	129	131	137	67.7	93.0	88.0	64.1	32.3	7.0	12.0	35.9
	2	2,670	420	90	-	136	129	130	137	71.9	92.0	95.6	-	28.1	8.0	4.4	-
	3 ¹	690	-	30	-	137	-	135	-	66.9	-	76.7	-	33.1	-	23.3	-
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σ	5,130	870	390	42	136	129	131	137	69.7	92.5	88.3	64.1	30.3	7.5	11.7	35.9

¹Through 25 August 1986.

²Annual percentages and mean lengths are weighted by landings in each quarter (Appendices 1-4) for 1978-1986.

Table 4. Sampling of surf clam shell lengths from commercial catches in Georges Bank (GBK) and Southern New England (SNE) assessment areas, 1984-1986.

Year	Quarter	Number of Clams Measured		Mean Shell Length(mm)		Percent clams <140 mm		Percent clams >140 mm	
		GBK	SNE	GBK	SNE	GBK	SNE	GBK	SNE
1984	1	-	-	-	-	-	-	-	-
	2	210	-	152	-	7.1	-	92.9	-
	3	420	-	150	-	17.7	-	82.3	-
	4	30	30	141	139	40.0	56.7	60.0	43.3
	Σ	660	30	151	139	13.6	56.7	86.4	43.3
1985	1	90	-	149	-	24.0	-	76.0	-
	2	300	-	148	-	22.0	-	78.0	-
	3	300	180	145	171	32.1	0.3	67.9	99.7
	4	-	240	-	167	-	0.0	-	100.0
	Σ	690	420	147	169	26.7	0.1	73.3	99.9
1986	1	90	90	138	170	59.2	0.0	40.8	100.0
	2	870	90	145	162	32.2	17.2	67.8	82.8
	3 ¹	210	60	145	157	28.6	3.3	71.4	96.7
	4	-	-	-	-	-	-	-	-
	Σ	1170	240	144	164	36.0	5.3	64.0	94.7

¹Through 25 August 1986.

Table 5. Summary of research vessel survey cruises used in the analysis of surf clam population dynamics, 1965-1986.

Research Vessel	Dates of Cruise	Dredge Knife Width (cm)	Time of Tow (min)	Number of Stations	Ring size or ^a Bar Space (CM)
UNDAUNTED	5- 6 1965	76	5	375(293) ^b	5.1
UNDAUNTED	10- 11 1965	76	5	217(158)	5.1
ALBATROSS IV	8 1966	76	5	240(210)	5.1
ALBATROSS IV	6- 7 1969	76	5	278(166)	5.1
DELAWARE II	8 1970	122	4	199(133)	3.0
DELAWARE II	6 1974	76	5	241(142)	5.1
DELAWARE II	4- 5 1976	122	4	259(133)	3.0
DELAWARE II	1- 3 1977	122	4	244(92)	3.0
DELAWARE II	1- 2 1978	122	4	324(192)	3.0
DELAWARE II	12 1978	122	4	163(105)	2.5
DELAWARE II	1- 2 1980	152	5	229(156)	5.1
DELAWARE II	8- 9 1980	152	5	231(114)	5.1
DELAWARE II	8 1981	152	5	261(119)	5.1
DELAWARE II	8 1982	152	5	272(151)	5.1
DELAWARE II	8 1983	152	5	381(169)	5.1
DELAWARE II	7 1984	152	5	448(241)	5.1
DELAWARE II	6- 7 1986	152	5	334(296)	5.1

^aPortion of the dredge where catch is accumulated.

^bNumber of stations located in surf clam assessment areas.

no table #6

Table 7. Stratified mean number and weight (meats only, kg) per tow of surf clams from NMFS surveys off northern New Jersey, 1965-1986. Data are standardized to a 60-inch wide dredge towed for five minutes.

Survey	Total index		<5½"		≥5½"		% ≥ 5½"	
	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight
May 1965	38.07	4.79	15.44	1.17	22.62	3.62	59.4	75.6
Oct 1965	35.73	5.27	6.18	0.51	29.55	4.76	82.7	90.3
Aug 1966	30.44	4.51	5.44	0.36	24.99	4.15	82.1	92.1
Jun 1969	34.26	5.37	3.93	0.30	30.33	5.07	88.5	94.4
Aug 1970	25.73	4.12	4.84	0.30	20.89	3.82	81.2	92.9
Jun 1974	21.40	3.37	2.75	0.19	18.66	3.17	87.2	94.3
Apr 1976	12.92	2.06	2.39	0.12	10.53	1.93	81.5	94.0
Jan 1977	2.45	0.23	1.39	0.05	1.06	0.19	43.2	81.4
Jan 1978	2.06	0.16	1.48	0.06	0.58	0.11	28.3	64.9
Dec 1978	44.88	1.20	43.85	1.03	1.01	0.17	2.3	14.8
Jan 1980	31.70	1.95	27.52	1.22	4.17	0.75	13.2	38.1
Aug 1980	53.56	3.74	50.66	3.24	2.90	0.50	5.4	13.5
Aug 1981	39.10	3.23	31.15	2.04	8.03	1.19	20.5	36.0
Aug 1982	112.79	8.78	101.53	7.11	11.26	1.67	9.9	19.0
Aug 1983	72.91	5.94	63.06	4.42	9.85	1.52	13.5	25.6
Jul 1984	64.88	5.47	52.71	3.70	12.17	1.77	18.8	32.3
Jun 1986	45.57	4.57	30.81	2.37	14.76	2.20	32.4	48.1

Table 8. Stratified mean number and weight (meats only, kg) per tow of surf clams from NMFS surveys off southern New Jersey, 1965-1986. Data are standardized to a 60-inch wide dredge towed for five minutes.

Survey	Total index		<5½"		≥5½"		% ≥ 5½"	
	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight
May 1965	105.98	8.88	78.08	4.37	27.93	4.49	26.4	50.7
Oct 1965	82.84	10.64	33.32	2.73	49.52	7.93	59.8	74.4
Aug 1966	69.55	9.95	14.62	1.39	54.93	8.56	79.0	86.0
Jun 1969	59.73	9.08	5.46	0.42	54.27	8.66	90.9	95.3
Aug 1970	16.18	2.65	2.73	0.20	13.45	2.45	83.1	92.1
Jun 1974	49.31	8.85	2.22	0.16	47.10	8.69	95.5	98.2
Apr 1976	5.20	0.97	0.64	0.03	4.57	0.94	87.8	96.1
Jan 1977	2.25	0.23	1.22	0.03	1.03	0.20	45.5	89.3
Jan 1978	14.91	2.23	3.85	0.22	11.06	2.00	74.2	89.9
Dec 1978	8.60	0.97	4.45	0.23	4.15	0.75	48.3	76.4
Jan 1980	13.59	2.29	2.53	0.22	11.06	2.09	81.4	90.7
Aug 1980	14.57	2.59	2.95	0.20	11.62	2.39	79.7	92.0
Aug 1981	10.47	2.06	0.56	0.03	9.91	2.03	94.7	98.5
Aug 1982 ¹	20.61	3.51	3.62	0.19	16.99	3.32	82.5	94.7
Aug 1983	11.51	2.15	1.50	0.10	10.01	2.05	87.0	95.3
Jul 1984	10.30	1.93	0.84	0.06	9.46	1.87	91.8	96.9
Jun 1986	18.96	3.17	4.29	0.19	14.67	2.98	77.4	94.0

¹Index does not include one survey tow made at a depth of seven meters that yielded 500 surf clams.

Table 9. Stratified mean number and weight (meats only, kg) per tow of surf clams from NMFS surveys off Delmarva, 1965-1986. Data are standardized to a 60-inch wide dredge towed for five minutes.

Survey	Total index		<5½"		≥5½"		% ≥5½"	
	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight
May 1965	27.68	2.26	15.82	0.83	11.86	1.44	42.8	63.3
Oct 1965	28.02	2.81	10.76	0.58	17.25	2.23	61.6	79.3
Aug 1966	32.53	3.54	10.75	0.64	21.78	2.90	67.0	81.9
Jun 1969	26.26	2.78	8.03	0.50	18.22	2.28	69.4	82.0
Aug 1970	19.64	2.34	4.71	0.30	14.93	2.04	76.0	87.5
Jun 1974	36.66	4.59	6.68	0.42	29.98	4.17	81.8	90.7
Apr 1976	21.93	2.37	7.30	0.25	14.63	2.12	66.7	89.6
Jan 1977	11.37	1.40	2.68	0.09	8.69	1.31	76.4	93.2
Jan 1978	11.61	1.15	4.90	0.17	6.71	1.00	57.7	85.4
Dec 1978	621.33	6.02	616.44	5.32	4.88	0.72	0.8	88.2
Jan 1980	68.50	3.17	58.07	1.62	10.44	1.54	15.2	48.7
Aug 1980	48.53	2.64	39.39	1.26	9.14	1.37	18.8	52.2
Aug 1981	162.89	6.91	156.86	6.02	6.02	0.89	3.7	12.9
Aug 1982	109.14	5.68	102.53	4.71	6.61	0.97	6.1	17.0
Aug 1983	51.39	3.79	39.36	2.14	12.03	1.65	23.4	43.5
Jul 1984	129.19	5.58	119.17	4.27	10.02	1.31	7.8	23.5
Jun 1986	104.62	7.28	94.49	5.91	10.13	1.37	9.7	18.8

Table 10. Stratified mean number per tow of surf clams from NMFS surveys off southern Virginia - North Carolina, 1965-1986. Data are standardized to a 60-inch wide dredge towed for five minutes.

Survey	Total index		<5½"		≥5½"		% ≥5½"	
	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight
May 1965	3.77		2.87		0.90		23.9	
Oct 1965 ¹	11.93		11.81		0.12		1.0	
Aug 1966 ¹	17.56		16.28		1.27		7.3	
Jun 1969	80.02		78.68		1.34		1.7	
Aug 1970 ¹	3.20		0.74		2.46		76.7	
Jun 1974	30.09		12.66		17.42		57.9	
Apr 1976	6.21		1.11		5.10		82.2	
Jan 1978	3.24		1.06		2.18		67.3	
Jan 1980 ¹	87.02		86.15		0.87		1.0	
Aug 1981 ¹	25.89		17.97		7.92		30.6	
Aug 1982 ¹	2.06		1.18		0.88		42.6	
Aug 1983	10.25	0.55	9.11	0.44	1.14	0.11	11.1	20.0
Jul 1984	20.78	1.32	15.50	0.82	5.28	0.50	25.4	37.9
Jun 1986	16.56	1.14	12.91	0.83	3.65	0.31	22.0	27.2

Only a small portion of the total southern Virginia - North Carolina area was surveyed.

Table 11. Calculations of the percentages of surf clam resources by size interval for seven assessment areas off the northeast USA, based on the June-July 1986 survey by the R/V DELAWARE II. Calculations of the percent of total resource in each area are also given.

	-----ASSESSMENT AREA ¹ -----						
	NNJ	SNJ	DMV	SVA-NC	LI	SNE	GBK
Meat Weight per tow (kg)	4.57	3.17	7.28	1.14	0.23	0.84	1.72
Percent of Area Resource (weight) by Length							
0-4 3/4"	13.6	4.1	35.1	5.3	8.7	3.6	34.3
4 3/4-5"	9.2	0.3	20.2	9.6	1.4	1.2	12.8
5-5 1/4"	11.8	0.6	14.8	21.1	1.4	1.2	14.0
5 1/4-5 1/2"	17.3	1.0	11.1	36.8	1.4	2.4	17.4
<u>>5 1/2"</u>	48.1	94.0	18.8	27.2	87.1	91.6	21.5
Number Per Tow	45.57	18.96	104.62	16.56	1.79	6.33	26.88
Percent of Area Resource (Number) by Length							
0-4 3/4"	27.8	19.7	47.7	8.0	28.5	18.5	60.5
4 3/4-5"	11.0	0.4	19.9	11.0	1.1	1.1	9.6
5-5 1/4"	12.5	0.9	13.8	21.5	1.7	1.6	9.4
5 1/4-5 1/2"	16.3	1.6	8.9	37.5	2.2	2.4	10.8
<u>>5 1/2"</u>	32.4	77.4	9.7	22.0	66.5	76.4	9.7
Surveyed Area (n. miles ²)	3440	1228	5092	2805	2945	4174	5833 ²
Percent of Total Resource (#'s)	16.5	2.5	56.2	4.9	0.6	2.8	16.5
Percent of Total Resource (weight)	21.2	5.3	50.0	4.3	0.9	4.7	13.5

¹NNJ = Northern New Jersey; SNJ = Southern New Jersey; DMV = Delmarva; SVA-NC = Southern Virginia-North Carolina; LI = Long Island; SNE = Southern New England; GBK = Georges Bank.

²For the purposes of these calculations, portions of some Georges Bank strata were considered unfishable. The proportions of area assumed fishable are: 54-0.90, 55-0.90, 57-0.80, 63-0.60, 64-0.50, 65-0.50, 66-0.50, 67-0.80, 68-0.75, 69-0.70, 70-0.75, 71-0.70, 72-0.50, 73-0.50, 74-0.70.

SURF CLAM LANDINGS -- 1965-1985

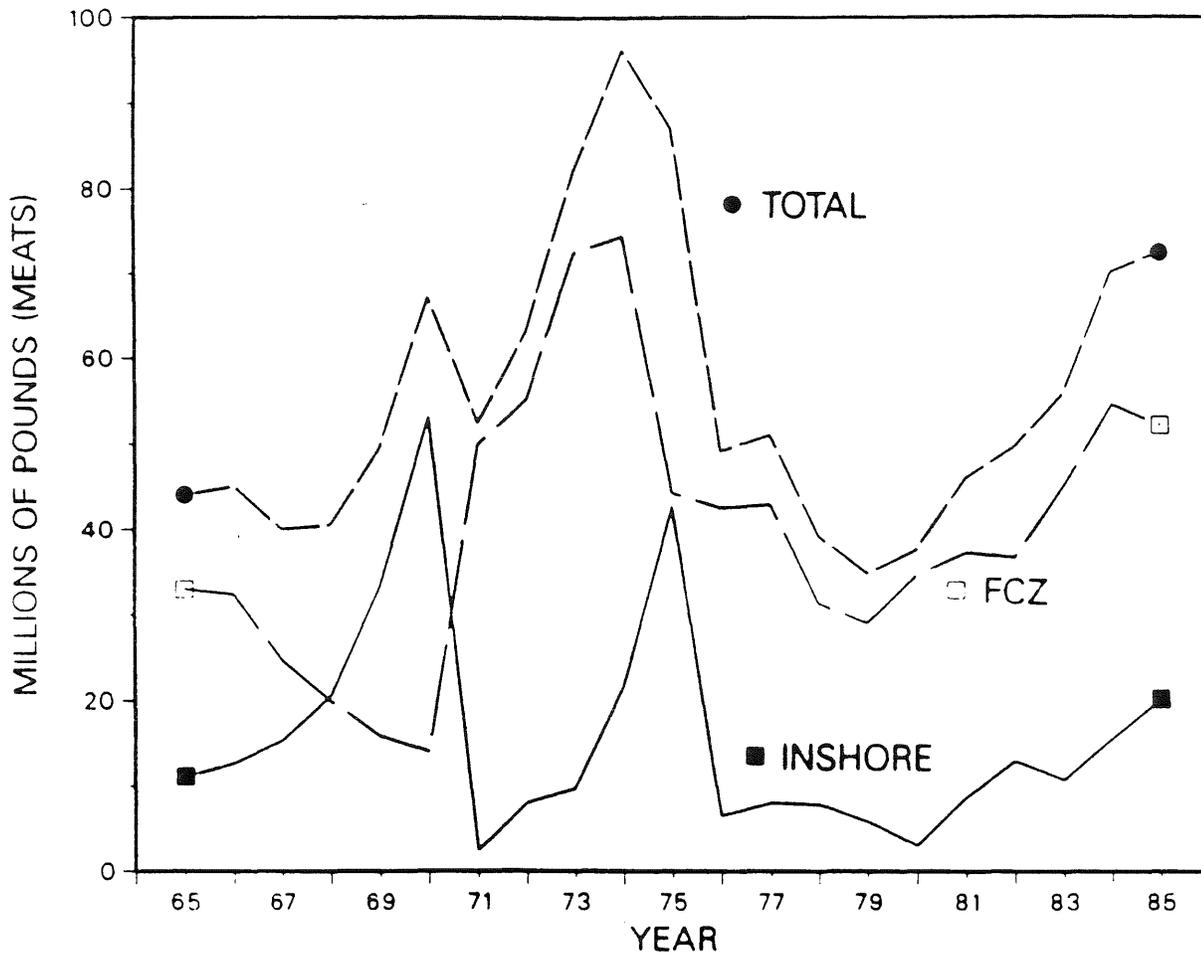


Figure 1. Landings of surf clams (millions of pounds of meats), 1965-1985. Data are for all areas (total), Fishery Conservation Zone (FCZ). 3-200 miles from the coast), and State (inshore) waters.

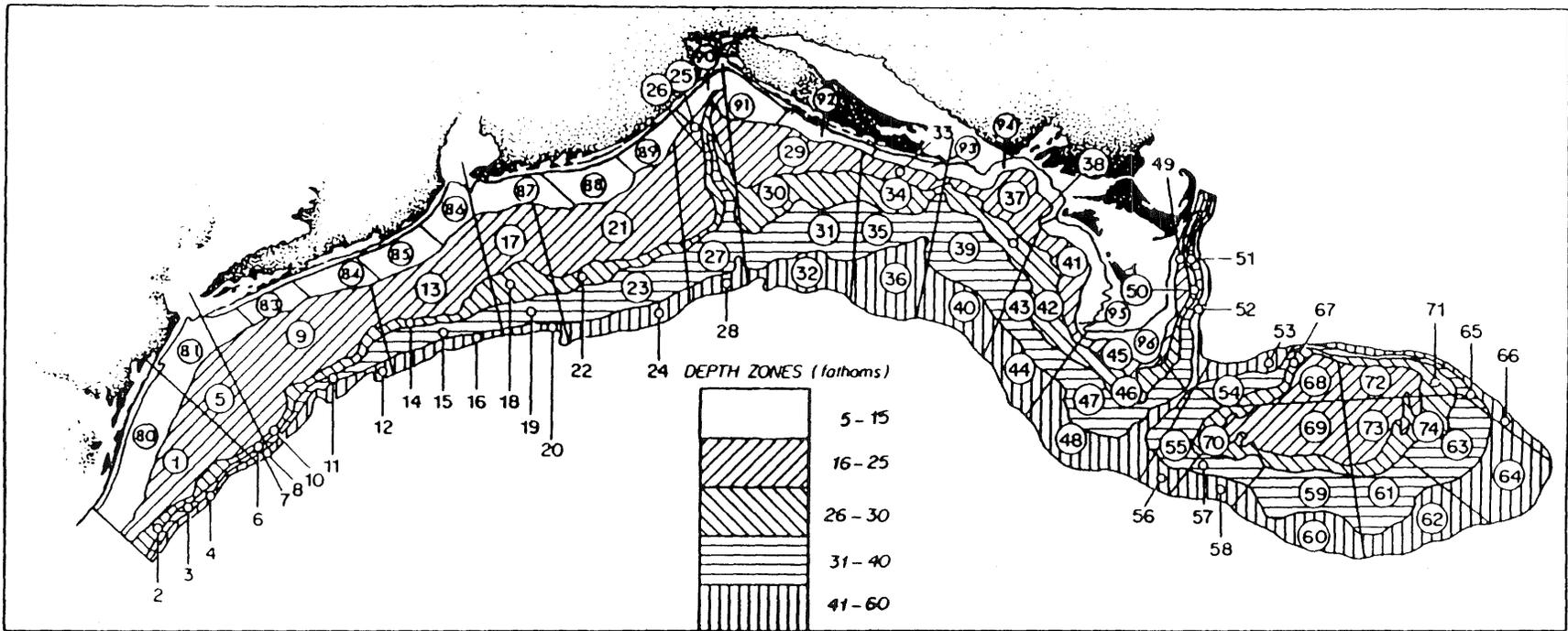
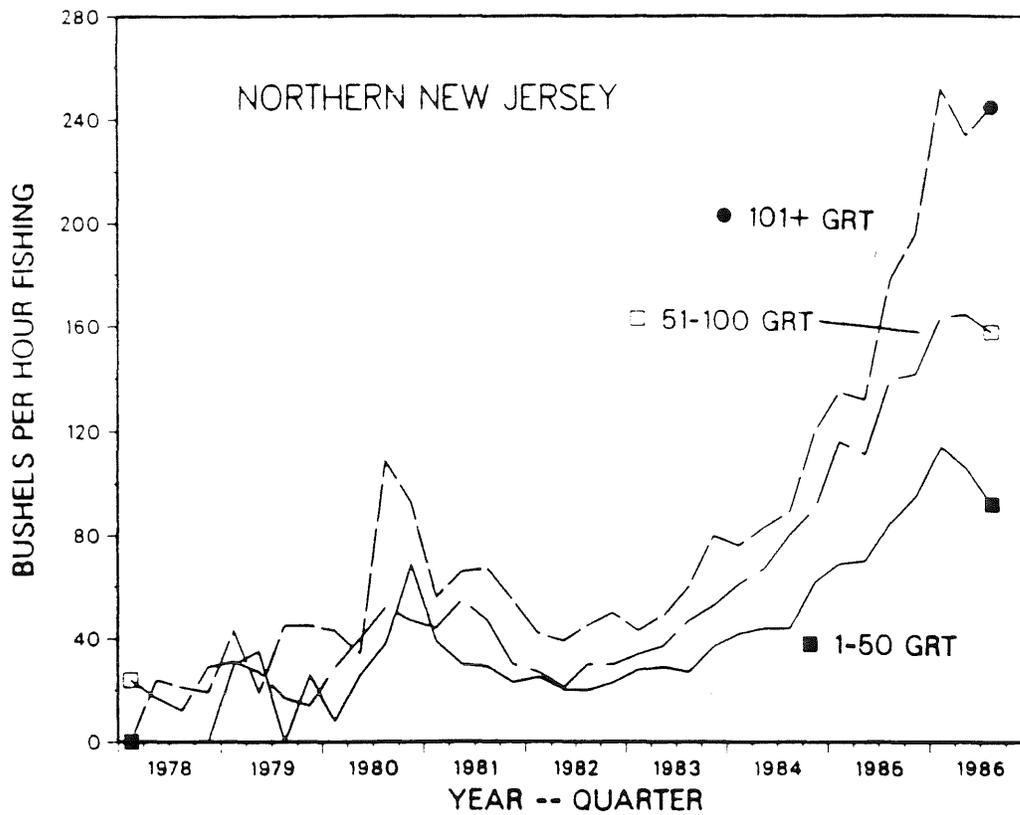


Figure 2. Ocean shellfish survey strata off the northeast United States. Areas and depths of individual strata are given in Table 6.



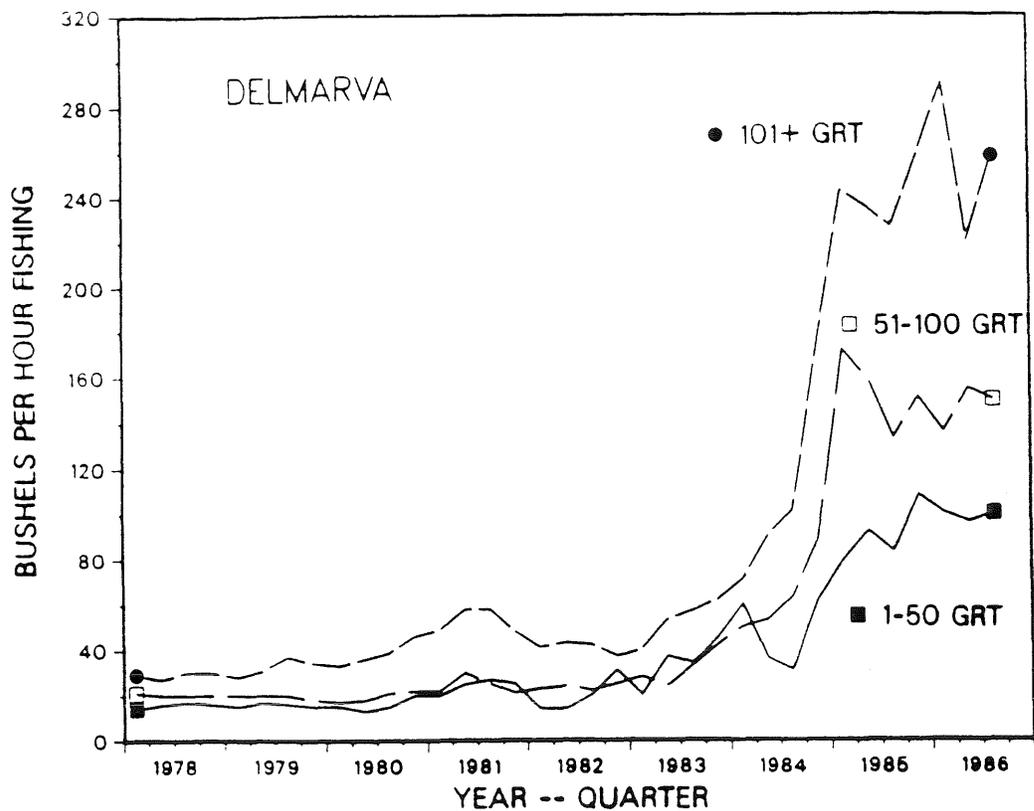


Figure 5. Catch per unit of effort (bushels per hour fishing) for three vessel size classes operating off Delmarva, 1978-1986. Quarterly data were derived from vessel trip logbooks, and are for all sizes of clams landed.

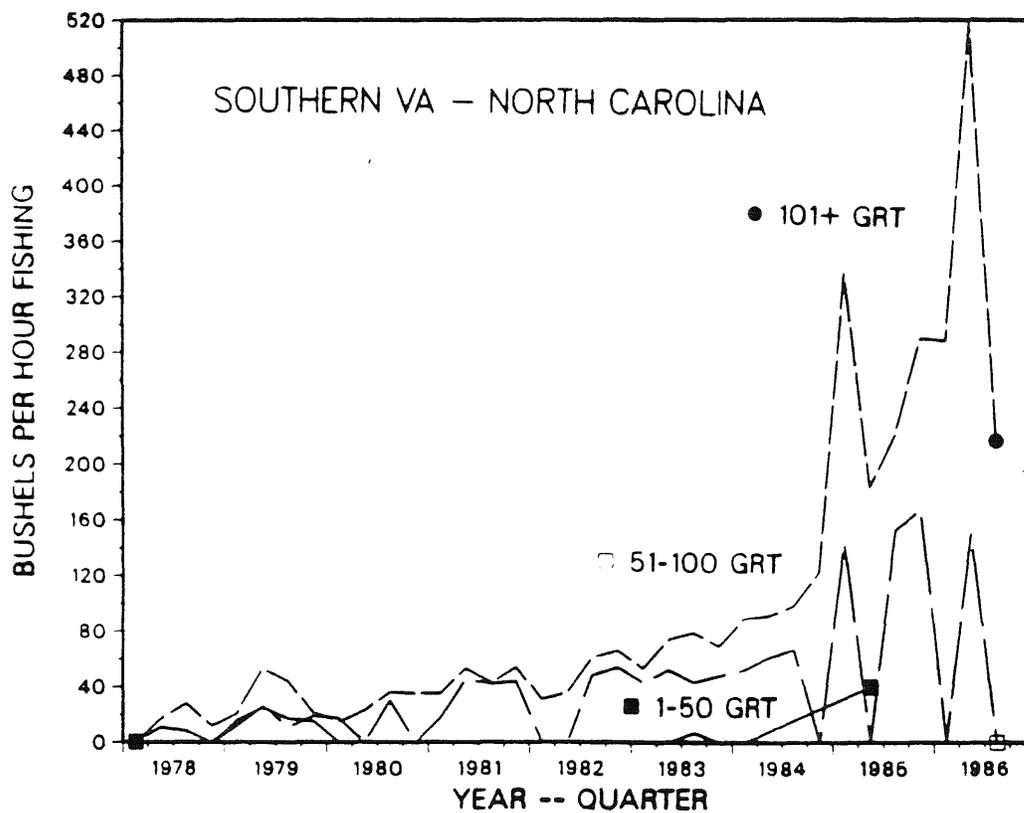


Figure 6. Catch per unit of effort (bushels per hour fishing) for three vessel size classes operating off southern Virginia-North Carolina, 1978-1986. Quarterly data were derived from vessel trip logbooks, and are for all sizes of clams landed.

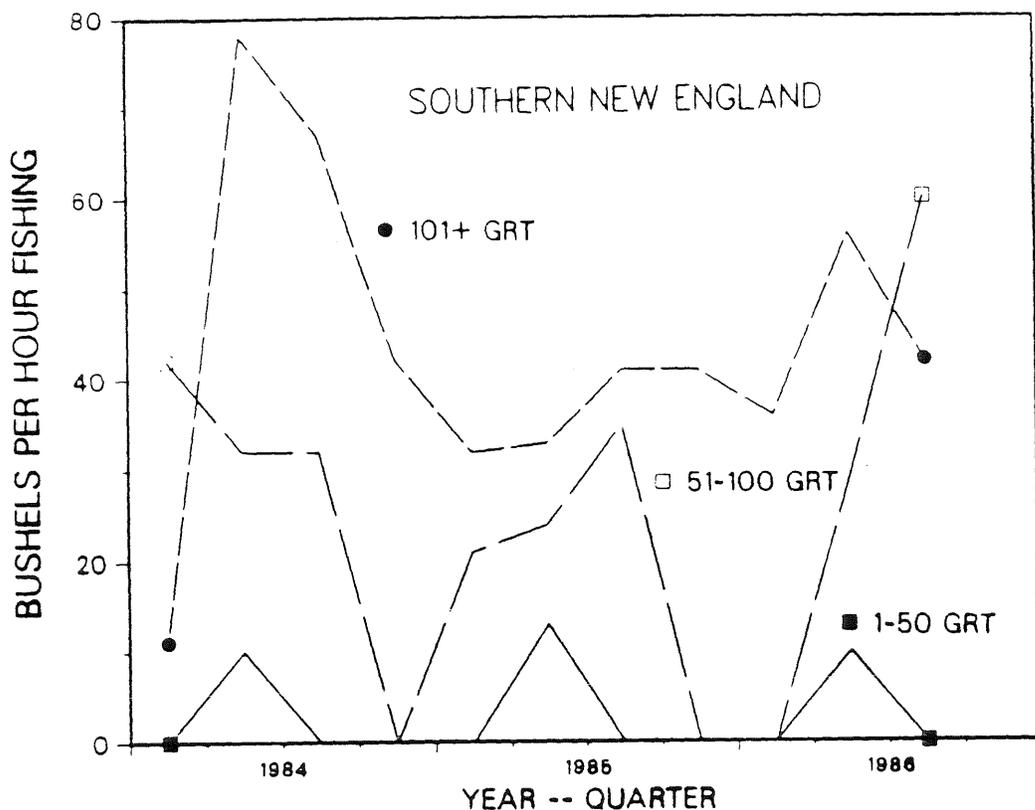


Figure 7. Catch per unit of effort (bushels per hour fishing) for three vessel size classes operating off southern New England, 1984-1986. Quarterly data were derived from vessel trip logbooks, and are for all sizes of clams landed.

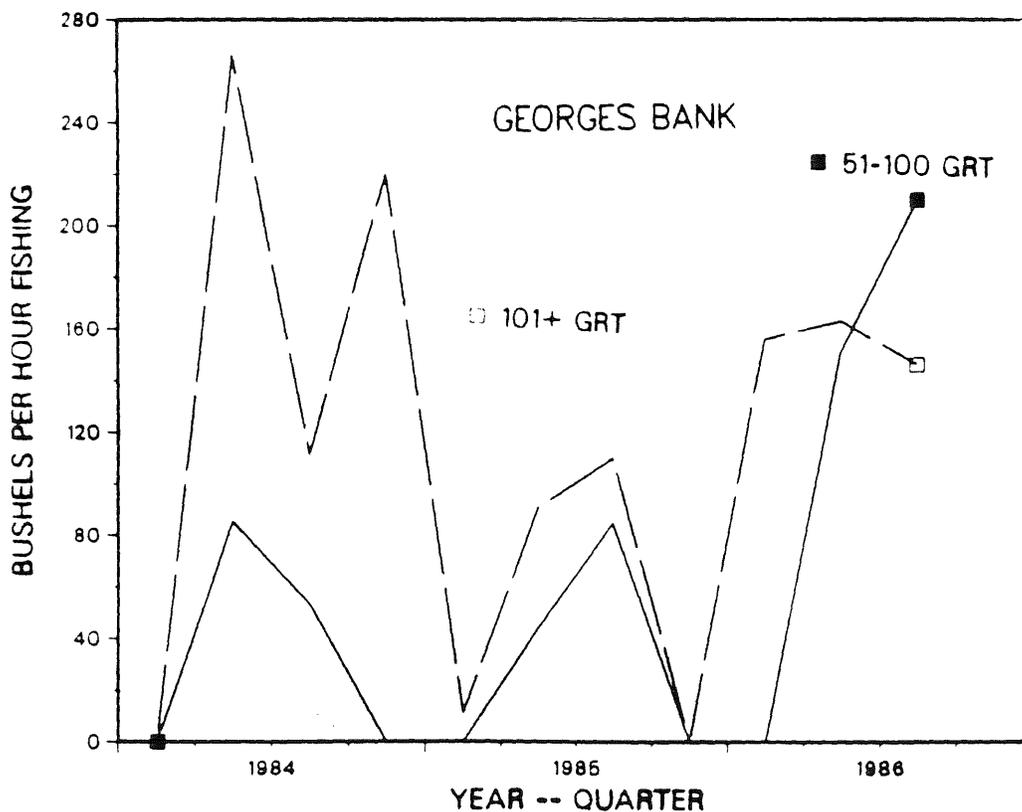


Figure 8. Catch per unit of effort (bushels per hour fishing) for two vessel size classes operating on Georges Bank, 1984-1986. Quarterly data were derived from vessel trip logbooks, and are for all sizes of clams landed.

SURF CLAM DISCARD DATA 1982-1986

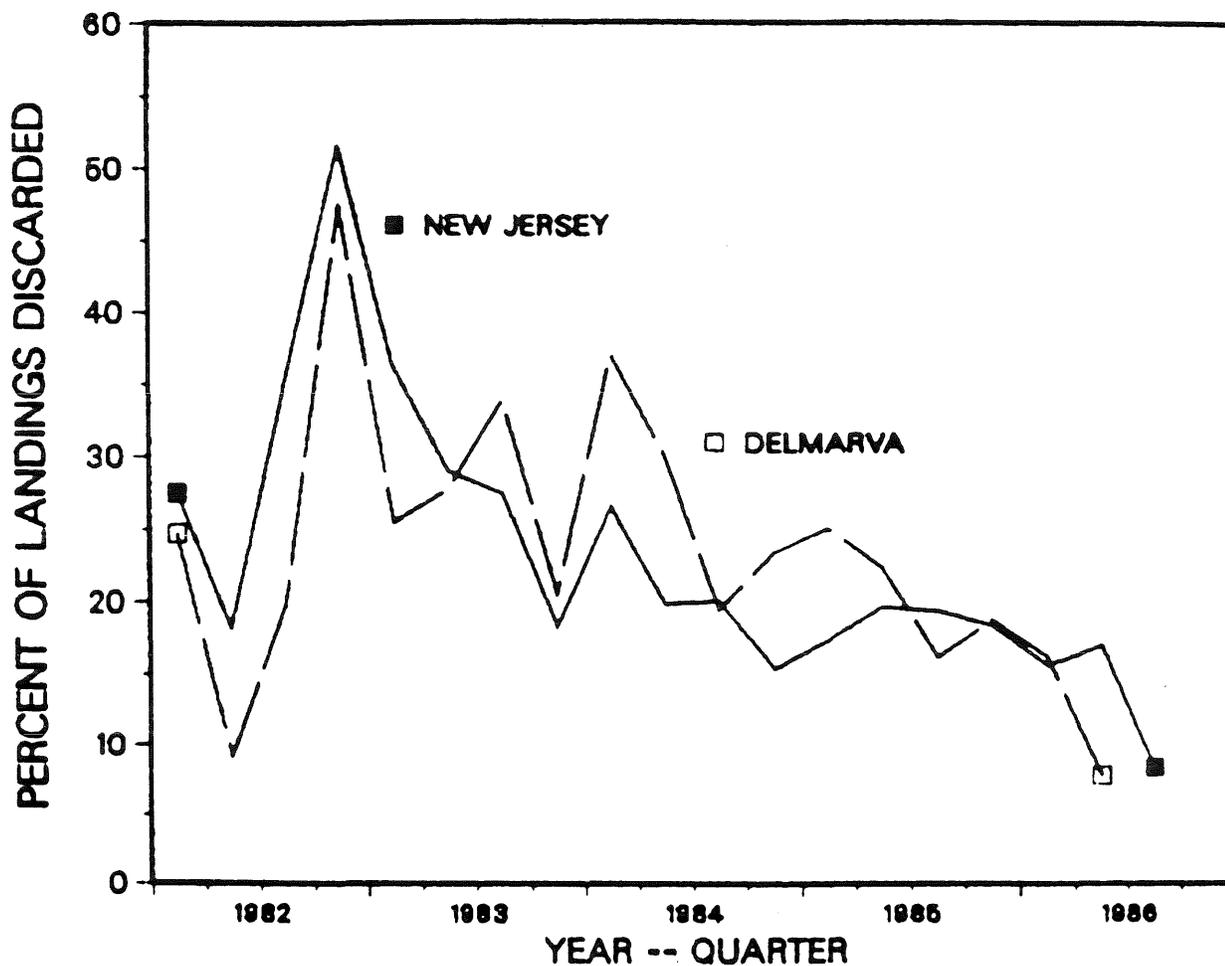


Figure 9. Discard of small surf clams as a percentage of landings (bushels) for two Middle Atlantic assessment areas (NJ = New Jersey, DMV = Delmarva). Quarterly data were obtained through NMFS port agent interviews.

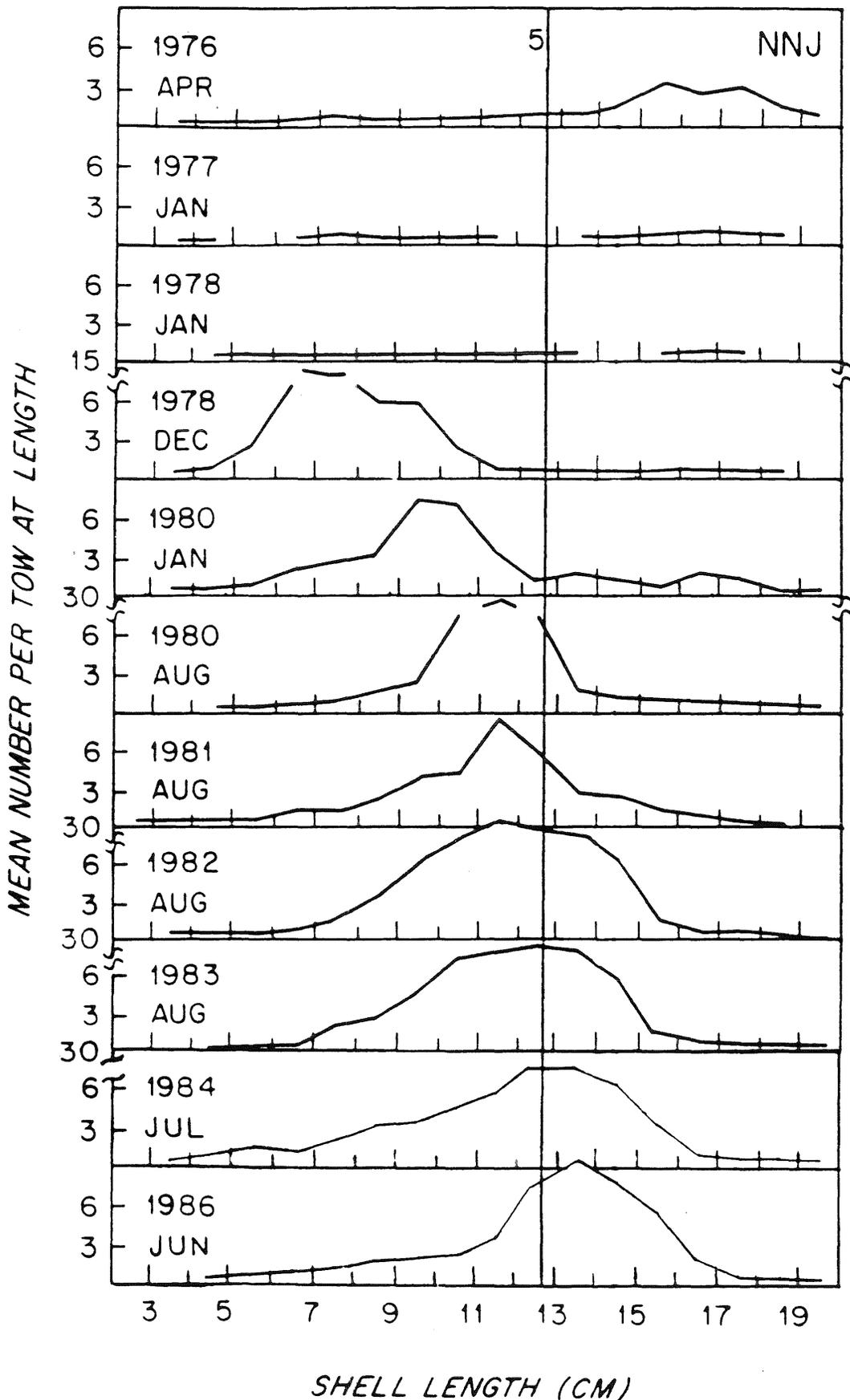


Figure 10. Stratified mean number of surf clams per standardized tow at each one centimeter length group in NMFS shellfish surveys off northern New Jersey, 1976-1986. Vertical line indicates current 5" minimum size limit.

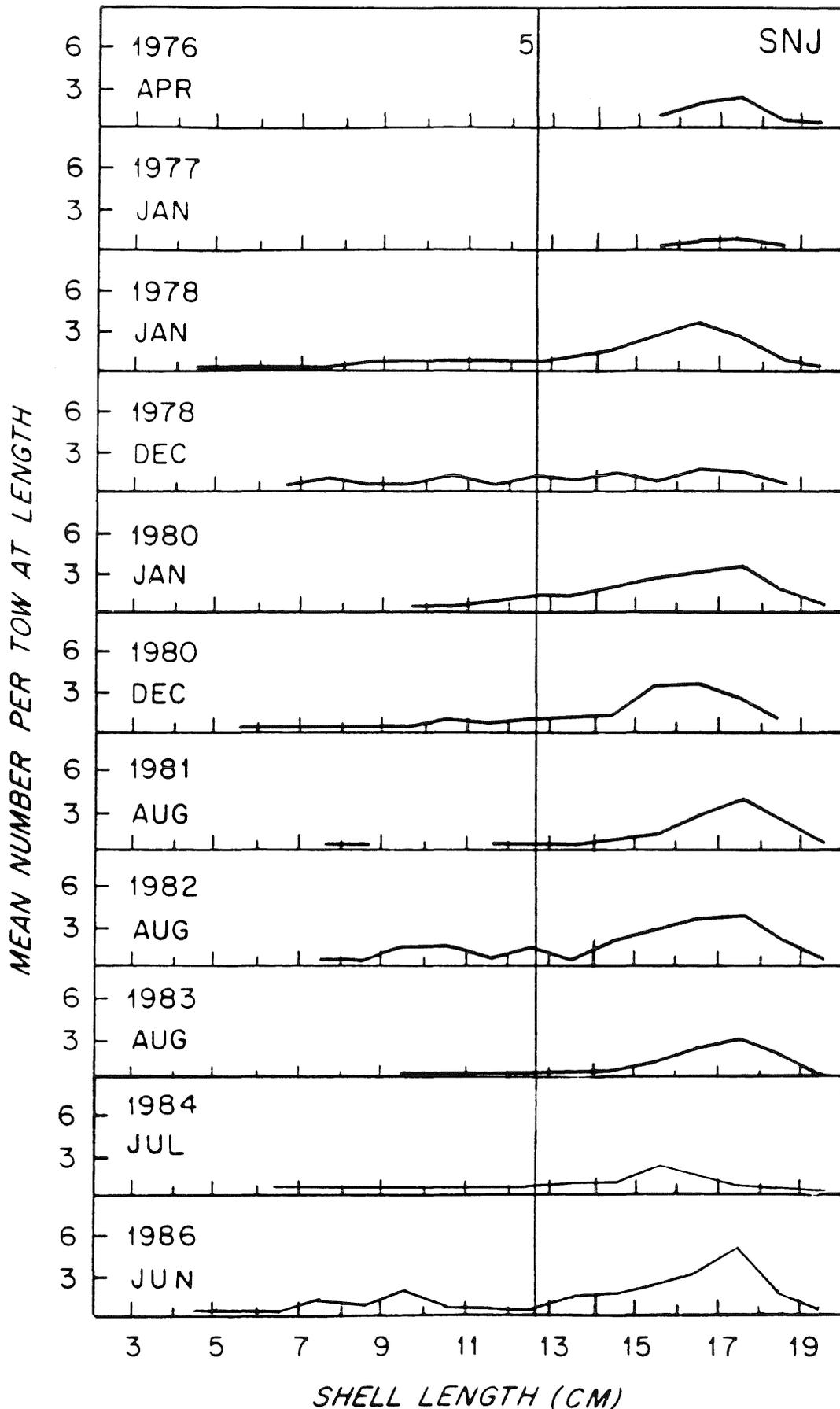


Figure 11. Stratified mean number of surf clams per standardized tow at each one centimeter length group in NMFS shellfish surveys off southern New Jersey, 1976-1986. Vertical line indicates current 5" minimum size limit.

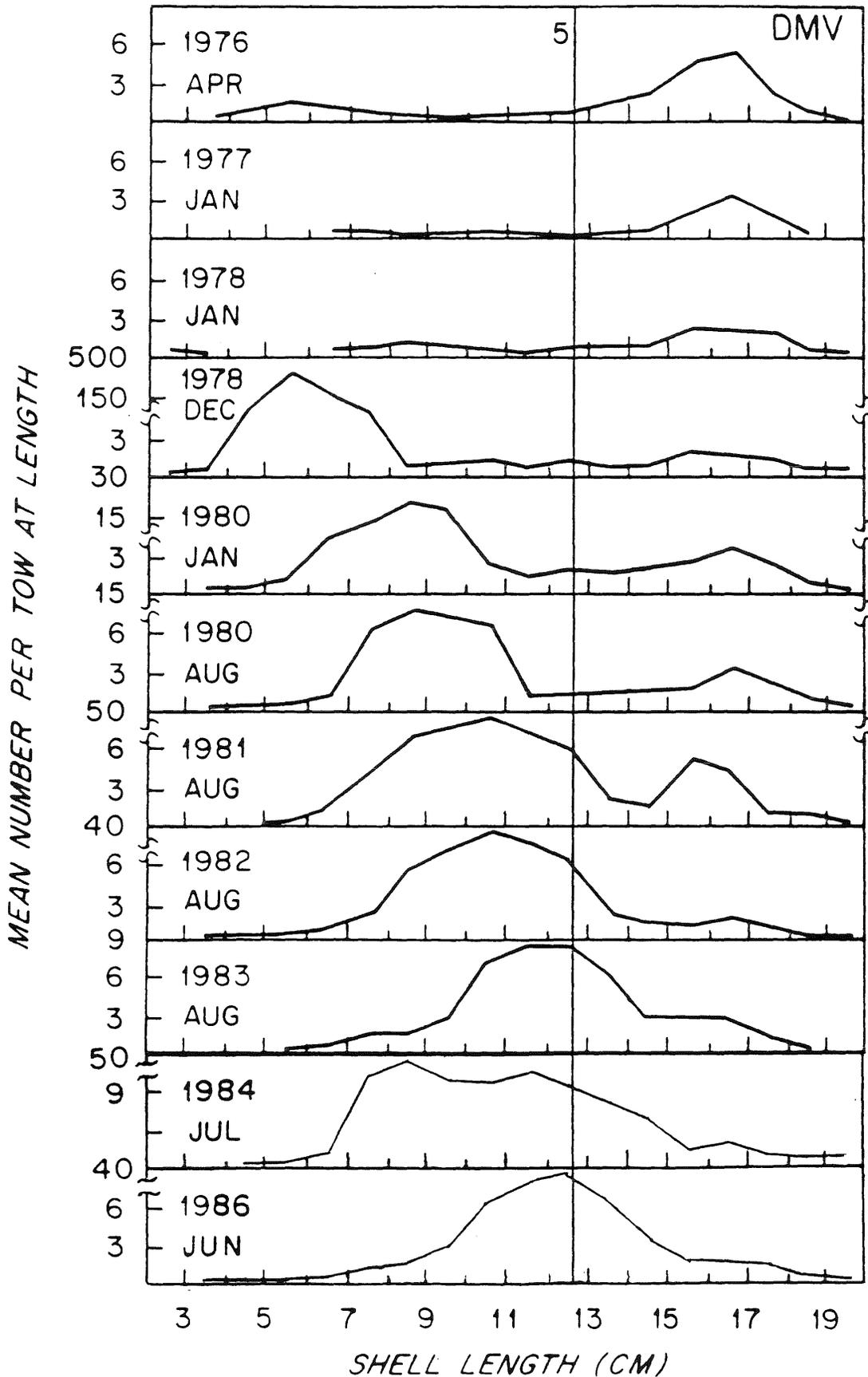


Figure 12. Stratified mean number of surf clams per standardized tow at each one centimeter length group in NMFS shellfish surveys off Delmarva, 1976-1986. Vertical line indicates current 5" minimum size limit.

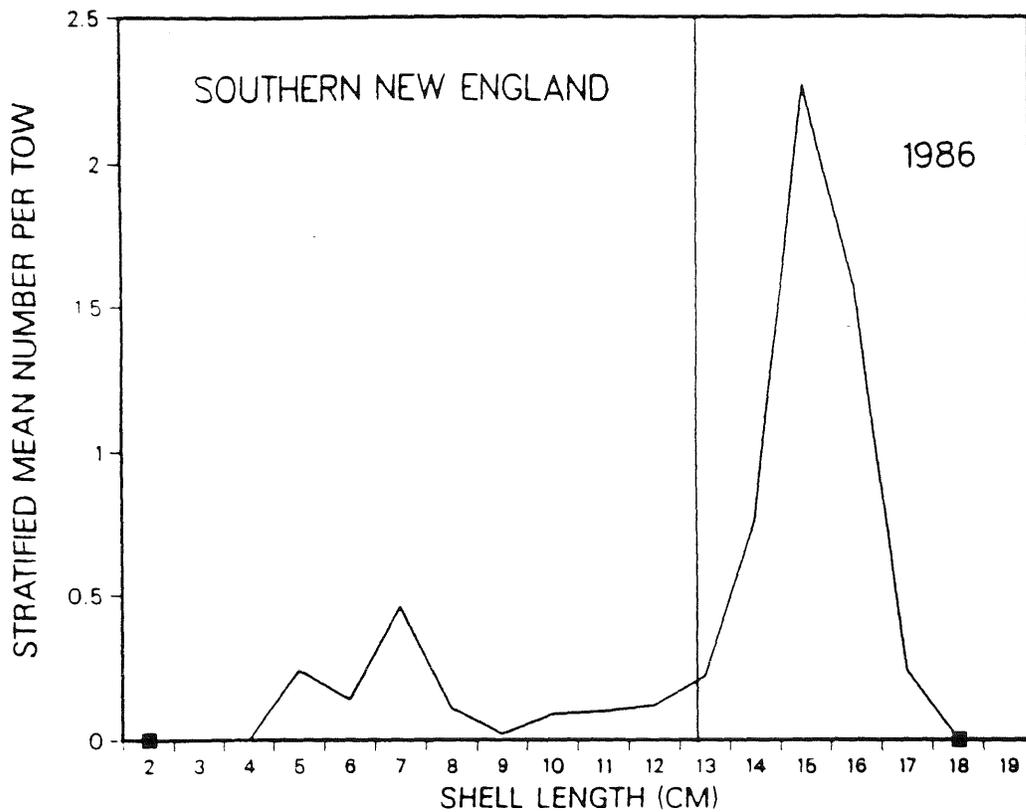


Figure 13. Stratified mean number of surf clams per standardized tow at each one centimeter length group in NMFS shellfish surveys off southern New England-1986. Vertical line indicates current 5" minimum size limit.

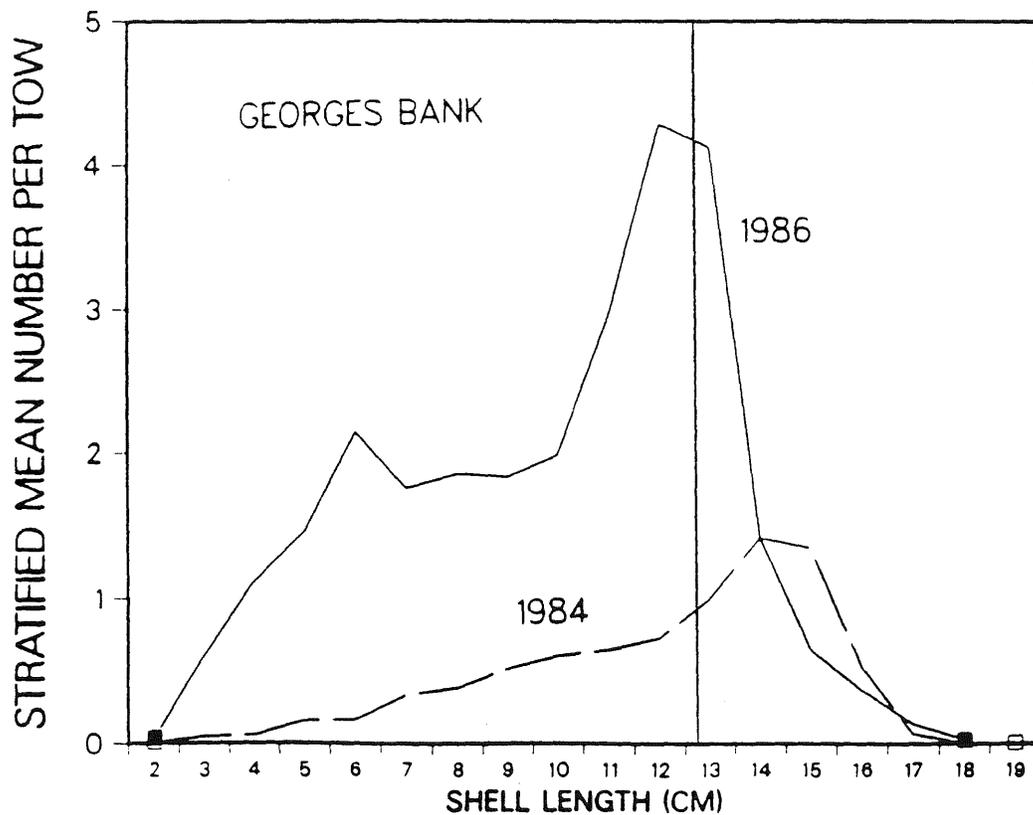


Figure 14. Stratified mean number of surf clams per standardized tow at each one centimeter length group in NMFS shellfish surveys on Georges Bank, 1984-1986. Vertical line indicates current 5" minimum size limit.

SURF CLAM LENGTH DISTRIBUTION 1986

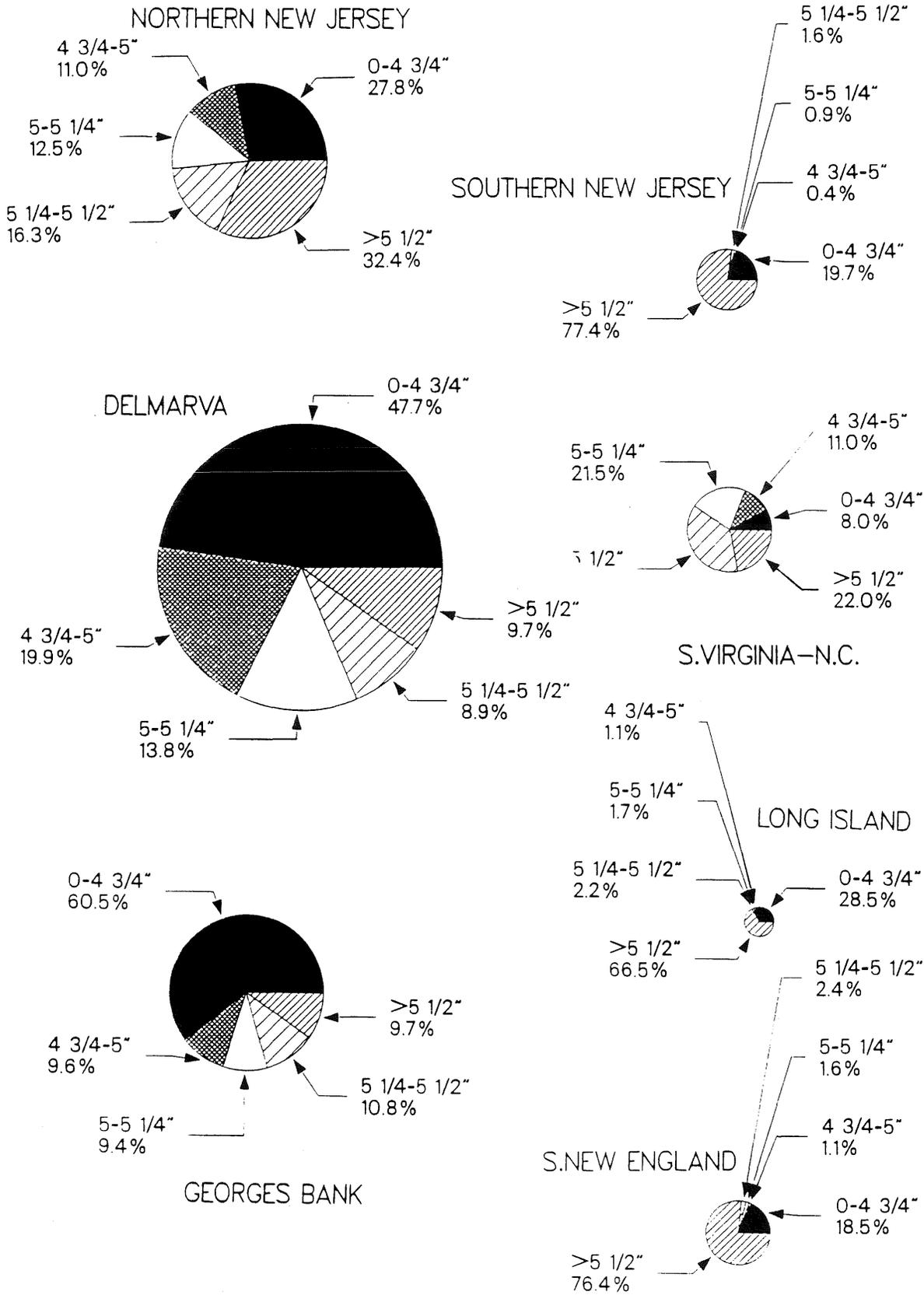


Figure 15. Size distributions of surf clams taken during the June-July 1986 NEFC clam survey off the northeast USA. Data are presented for seven different assessment areas and are expressed as a percentage of the total number per tow index for each area. Areas of the pie charts are proportional to the numbers of clams in each assessment area (Table 11).

SURF CLAM BIOMASS DISTRIBUTION 1986

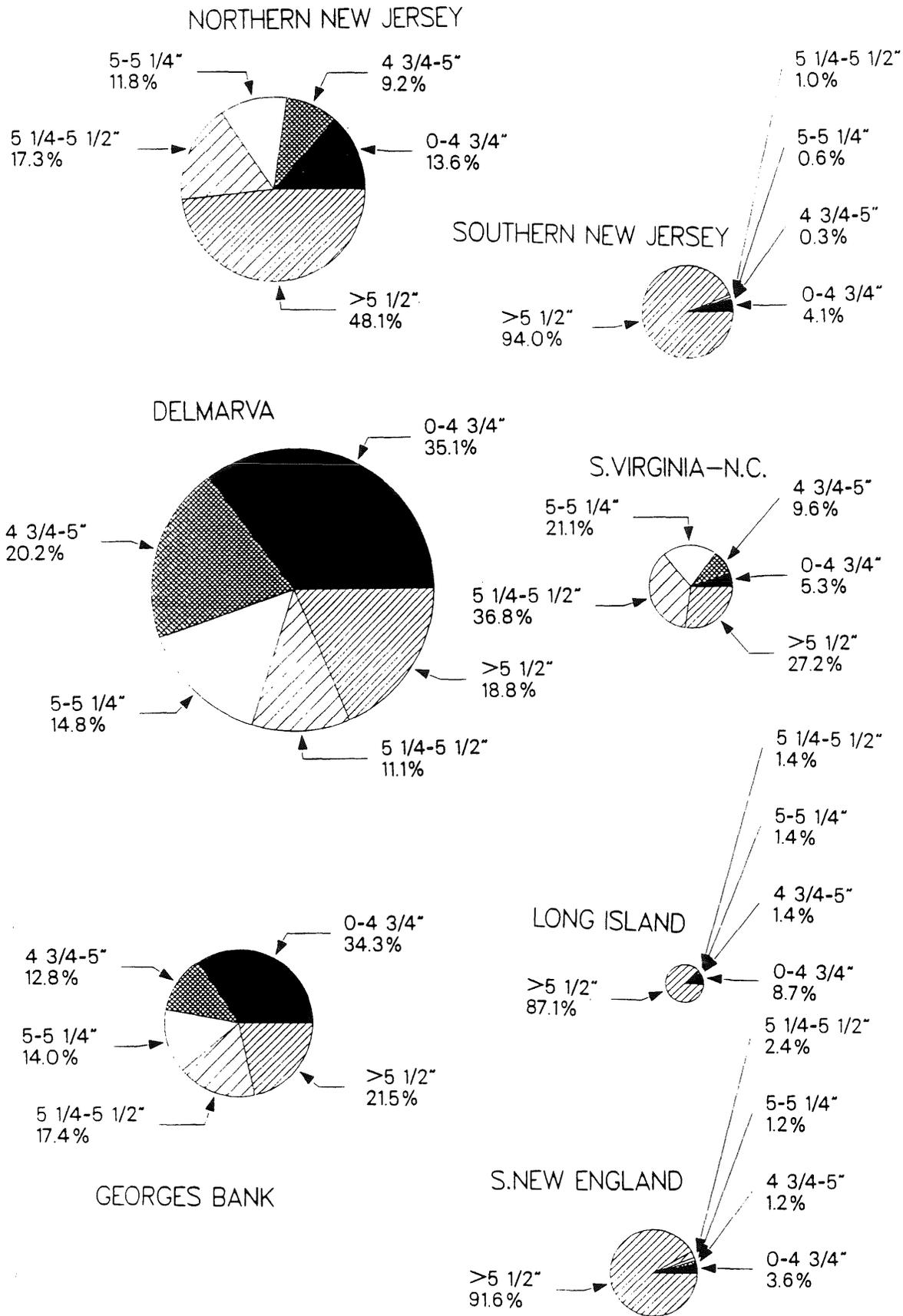


Figure 16. Size distributions of surf clams taken during the June-July 1986 NEFC clam survey off the northeast USA. Data are presented for seven different assessment areas and are expressed as a percentage of the total weight per tow index for each area. Areas of the pie charts are proportional to the weight of clams in each assessment area (Table 11).

Appendix 1. Commercial surf clam catch and effort statistics for the northern New Jersey assessment area, 1978-1986. Data are presented by calendar quarter for each of three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed			Total Catch (Hundreds of Bushels)			Total Hours Fished			Mean Bushels/Hour			
	Vessel Class			Vessel Class			Vessel Class			Vessel Class			
	1	2	3	1	2	3	1	2	3	1	2	3	
1978	1	-	2	-	-	4	-	-	16	-	-	25	-
	2	-	11	13	-	18	65	-	104	271	-	17	24
	3	-	37	12	-	48	34	-	385	159	-	12	21
	4	-	14	13	-	23	32	-	79	167	-	29	19
	Total	-	64	38	-	93	131	-	584	597	-	16	22
1979	1	6	17	8	17	44	24	56	142	57	30	31	42
	2	3	26	27	12	58	54	36	213	279	33	27	19
	3	-	6	6	-	12	23	-	70	57	-	17	40
	4	2	8	20	4	15	126	15	107	277	27	14	45
	Total	11	57	61	33	129	227	107	532	670	31	24	34
1980	1	26	12	17	5	34	84	62	118	197	8	29	43
	2	6	31	23	11	146	111	40	368	324	28	40	34
	3	3	20	38	9	93	299	24	178	274	38	52	109
	4	9	51	78	57	210	537	82	449	578	70	47	93
	Total	44	114	156	82	483	1031	208	1113	1373	39	43	75
1981	1	24	134	150	71	510	816	184	1148	1452	39	44	56
	2	39	225	186	104	995	1171	350	1818	1768	30	55	66
	3	42	200	267	109	894	1925	381	1895	2858	29	47	67
	4	28	108	242	65	330	1438	258	1120	2639	25	29	54
	Total	133	667	845	349	2729	5350	1173	5981	8717	30	46	61
1982	1	72	212	252	162	585	1172	651	2143	2787	25	27	42
	2	48	213	275	105	494	1229	519	2366	3184	20	21	39
	3	61	222	114	111	479	573	560	2301	1268	20	21	45
	4	54	236	136	117	687	713	504	2330	1416	23	29	50
	Total	235	883	777	495	2245	3687	2234	9140	8655	22	25	43
1983	1	51	214	204	166	697	904	592	2044	2101	28	34	43
	2	46	175	121	151	640	617	516	1727	1266	29	37	49
	3	48	242	83	144	1159	404	522	2460	677	28	47	60
	4	60	266	124	228	1270	672	620	2394	837	37	53	80
	Total	205	897	532	689	3766	2597	2250	8625	4881	31	44	53
1984	1	47	375	121	206	2146	795	485	3495	1043	42	61	76
	2	23	241	98	108	1535	853	243	2274	1030	44	67	83
	3	16	195	89	75	1529	847	170	1910	953	44	80	89
	4	16	198	127	77	1441	1225	125	1607	1025	62	90	120
	Total	102	1009	435	466	6651	3720	1023	9286	4051	46	72	92
1985	1	32	280	153	129	1839	1149	186	1580	849	69	116	135
	2	35	209	122	133	1348	911	190	1211	691	70	111	132
	3	24	150	117	128	1187	1206	151	847	675	85	140	179
	4	16	130	133	88	1060	1495	93	748	764	95	142	196
	Total	107	769	525	478	5434	4761	620	4386	2979	77	124	160
1986	1	28	184	175	177	1661	2519	155	1015	1000	114	164	252
	2 ¹	19	145	204	121	1298	2766	114	785	1183	106	165	234
	3	5	51	60	24	450	864	26	284	352	92	158	245
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	52	380	439	322	3409	6149	295	2084	2535	109	164	243

¹Through 25 August 1986.

Appendix 2. Commercial surf clam catch and effort statistics for the Southern New Jersey assessment area, 1978-1986. Data are presented by calendar quarter for each of three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed			Total Catch (hundreds of bushels)			Total Hours Fished			Mean Bushels/Hour			
	1	2	3	1	2	3	1	2	3	1	2	3	
1978	1	10	11	3	24	38	22	157	205	14	15	19	
	2	38	35	12	85	149	77	542	761	16	16	20	
	3	32	28	26	67	97	239	345	398	11	19	24	
	4	24	35	46	26	78	159	199	360	561	13	22	28
	Total	57	115	120	67	254	443	537	1404	1925	12	18	23
1979	1	11	53	7	20	164	26	100	676	27	20	24	
	2	38	78	7	55	176	23	253	944	30	22	19	
	3	90	37	52	171	136	210	951	406	25	18	33	
	4	35	27	5	53	135	48	367	352	10	14	38	
	Total	29	174	195	71	299	611	307	1671	2378	23	18	26
1980	1	20	23	4	30	123	32	230	315	13	13	39	
	2	42	29	9	88	131	67	503	378	13	17	35	
	3	64	14	6	91	81	52	659	129	12	14	63	
	4	19	11	1	40	40	10	183	95	10	22	42	
	Total	17	145	77	20	249	375	161	1575	917	12	16	41
1981	1	8	16	2	29	69	30	72	178	7	40	39	
	2	1	4	10	1	26	114	10	41	9	10	63	
	3	4	4	2	12	24	20	35	43	10	34	56	
	4	5	5	7	17	9	78	53	46	9	32	20	
	Total	28	18	29	21	59	128	242	170	308	9	35	42
1982	1	11	13	1	21	52	12	112	160	8	19	33	
	2	48	18	39	136	71	389	646	198	10	21	36	
	3	53	73	45	135	325	373	478	910	12	28	36	
	4	41	35	19	139	116	140	416	386	14	33	30	
	Total	96	153	139	104	431	564	914	1652	1654	11	26	34
1983	1	13	8	6	20	12	63	118	86	10	17	14	
	2	15	4	16	35	20	141	144	58	11	24	34	
	3	99	36	74	235	181	460	1033	365	16	23	50	
	4	67	48	49	273	291	275	617	443	18	44	66	
	Total	90	194	96	145	563	504	939	1912	952	15	29	53
1984	1	42	51	49	126	360	283	438	504	17	29	71	
	2	17	54	53	82	444	151	194	570	35	42	78	
	3	20	48	89	147	425	218	204	515	41	72	85	
	4	14	19	46	110	136	100	93	156	46	118	87	
	Total	77	93	172	237	465	1365	752	929	1745	32	50	78
1985	1	11	29	17	42	202	24	63	161	63	67	125	
	2	5	36	9	24	377	18	28	212	50	86	178	
	3	4	25	6	30	252	6	21	145	100	143	174	
	4	1	20	22	10	203	24	6	112	92	167	181	
	Total	21	110	54	106	1034	72	118	630	75	90	164	
1986	1	8	29	13	47	351	16	38	174	81	124	202	
	2	11	42	16	85	471	18	66	251	89	129	188	
	3 ¹	2	15	-	18	133	-	12	82	-	150	162	
	4	-	-	-	-	-	-	-	-	-	-	-	
	Total	6	21	86	29	150	955	34	116	507	85	129	188

¹Through 25 August 1986.

Appendix 3. Commercial surf clam catch and effort statistics for the Delmarva assessment area, 1978-1986. Data are presented by calendar quarter for each of three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed			Total Catch (Hundreds of Bushels)			Total Hours Fished			Mean Bushels/Hour			
	Vessel Class			Vessel Class			Vessel Class			Vessel Class			
	1	2	3	1	2	3	1	2	3	1	2	3	
1978	1	5	31	71	12	102	478	83	485	1633	14	21	29
	2	72	357	509	162	1071	2825	1044	5360	10511	16	20	27
	3	85	380	641	175	916	2567	1022	4602	8452	17	20	30
	4	56	319	536	93	802	2163	593	3961	7303	16	20	30
	Total	218	1087	1757	442	2891	8033	2742	14408	27899	16	20	29
1979	1	38	198	477	53	465	1890	344	2377	6658	15	20	28
	2	91	430	645	171	920	2641	1034	4628	8509	17	20	31
	3	77	426	732	144	965	3112	900	4815	8521	16	20	37
	4	50	265	493	86	569	2444	578	3167	7111	15	18	34
	Total	256	1319	2347	454	2919	10087	2856	14987	30799	16	19	33
1980	1	44	285	467	72	556	2234	494	3260	6694	15	17	33
	2	57	173	515	69	401	2850	527	2208	7826	13	18	36
	3	41	386	662	62	873	3287	421	4137	8742	15	21	38
	4	17	138	537	35	324	2653	172	1449	5803	20	22	46
	Total	159	982	2181	238	2154	11024	1614	11054	29065	15	19	38
1981	1	6	105	431	12	247	2323	58	1149	4784	21	21	49
	2	16	140	521	47	429	3361	186	1456	5843	25	29	58
	3	16	45	185	51	123	1178	186	484	2037	27	25	58
	4	1	45	100	3	90	518	10	429	1084	30	21	48
	Total	39	335	1237	113	889	7380	440	3518	13748	26	25	54
1982	1	8	75	337	11	185	1542	84	802	3793	13	23	41
	2	37	109	383	81	307	1917	425	1245	4458	19	25	43
	3	51	85	356	106	210	1656	545	956	3987	19	22	42
	4	31	35	258	99	90	1057	318	365	2832	31	25	37
	Total	127	304	1334	297	792	6172	1372	3368	15070	22	24	41
1983	1	21	26	270	42	84	1181	216	305	2984	19	28	40
	2	27	31	233	95	80	1495	259	329	2844	37	24	53
	3	21	75	406	83	281	2579	244	858	4538	34	33	57
	4	14	37	323	68	177	2267	151	417	3639	45	42	62
	Total	83	169	1232	288	622	7522	870	1909	14005	33	33	54
1984	1	22	38	309	141	226	2451	235	450	3465	60	50	71
	2	17	30	152	71	187	1520	200	352	1681	36	53	90
	3	16	27	62	58	197	705	186	315	698	31	63	101
	4	8	21	120	44	183	1721	71	208	983	62	88	175
	Total	63	116	643	314	793	6397	692	1325	6827	45	60	94
1985	1	8	22	216	30	223	3017	38	130	1242	79	172	243
	2	22	33	197	108	306	2764	118	193	1171	92	159	236
	3	14	16	72	65	120	971	78	90	428	83	133	227
	4	9	12	53	56	101	816	52	67	316	108	151	258
	Total	53	83	538	259	750	7569	286	480	3157	91	156	240
1986	1	7	16	102	35	133	1758	35	98	606	100	136	290
	2	9	10	52	52	85	697	54	55	315	96	155	221
	3 ¹	3	3	19	16	27	289	16	18	112	100	150	258
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	19	29	173	103	245	2744	105	171	1033	98	143	266

¹Through 25 August 1986.

Appendix 4. Commercial surf clam catch and effort statistics for the Southern Virginia - North Carolina assessment area, 1978-1986. Data are presented by calendar quarter for each of the three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed Vessel Class			Total Catch (hundreds of bushels) Vessel Class			Total Hours Fished Vessel Class			Mean Bushels/Hour Vessel Class		
	1	2	3	1	2	3	1	2	3	1	2	3
1978	1	-	-	-	-	-	-	-	-	-	-	-
	2	-	2	5	-	4	18	-	34	106	-	12
	3	-	1	1	-	1	4	-	9	15	-	11
	4	-	-	1	-	-	1	-	-	12	-	-
	Total	-	3	7	-	5	23	-	43	133	-	12
1979	1	1	3	1	3	5	1	17	39	6	18	13
	2	9	3	3	22	9	14	86	36	28	26	25
	3	3	8	1	8	24	5	46	112	12	17	21
	4	1	2	4	5	7	12	36	36	57	14	19
	Total	14	16	9	38	45	32	185	223	103	21	20
1980	1	-	2	3	-	2	5	-	14	33	-	14
	2	-	-	2	-	-	7	-	-	30	-	-
	3	-	1	7	-	1	29	-	5	82	-	20
	4	-	-	5	-	-	17	-	-	48	-	-
	Total	-	3	15	-	3	58	-	19	193	-	16
1981	1	-	4	5	-	7	29	-	38	85	-	18
	2	-	22	24	-	116	141	-	256	264	-	45
	3	-	12	9	-	60	46	-	144	106	-	42
	4	-	1	12	-	5	68	-	12	127	-	42
	Total	-	39	50	-	188	284	-	450	582	-	42
1982	1	-	-	16	-	-	53	-	-	175	-	-
	2	-	-	14	-	-	65	-	-	184	-	-
	3	-	13	34	-	74	251	-	156	411	-	47
	4	-	12	156	-	78	1244	-	144	1877	-	54
	Total	-	25	220	-	152	1613	-	300	2647	-	51
1983	1	-	4	57	-	20	357	-	48	676	-	42
	2	-	27	129	-	155	1160	-	298	1560	-	52
	3	1	28	96	¹ 2	137	884	4	319	1124	7	43
	4	-	30	40	-	167	317	-	346	459	-	48
	Total	1	89	322	¹ 2	479	2718	4	1011	3819	7	47
1984	1	-	16	34	-	99	340	-	192	381	-	52
	2	-	9	34	-	66	363	-	108	398	-	61
	3	-	4	12	-	32	141	-	48	144	-	67
	4	-	-	18	-	-	230	-	-	189	-	-
	Total	-	29	98	-	197	1074	-	348	1112	-	57
1985	1	-	6	5	-	52	101	-	36	30	-	144
	2	1	-	2	2	-	22	5	-	12	40	-
	3	-	6	21	-	49	266	-	32	120	-	153
	4	-	1	18	-	10	284	-	6	98	-	167
	Total	1	13	46	2	111	673	5	74	260	40	150
1986	1	-	-	16	-	-	262	-	-	91	-	-
	2	-	1	2	-	9	62	-	6	12	-	150
	3 ¹	-	-	2	-	-	26	-	-	12	-	-
	4	-	-	-	-	-	-	-	-	-	-	-
	Total	-	1	20	-	9	350	-	6	115	-	150

¹Through 25 August 1986.

Appendix 5. Commercial surf clam catch and effort statistics for the Southern New England assessment area, 1984-1986. Data are presented by calendar quarter for each of three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed Vessel Class			Total Catch (Hundreds of bushels) Vessel Class			Total Hours Fished Vessel Class			Mean Bushels/hour Vessel Class			
	1	2	3	1	2	3	1	2	3	1	2	3	
1984	1	-	17	1	-	85	4	-	203	36	-	42	11
	2	7	25	22	15	127	238	154	400	305	10	32	78
	3	-	16	1	-	88	10	-	278	15	-	32	67
	4	-	12	1	-	64	1	-	250	24	-	-	42
	Total	7	70	25	15	364	253	154	1131	380	10	32	67
1985	1	-	14	9	-	69	66	-	324	206	-	21	32
	2	2	6	20	2	33	156	15	137	468	13	24	33
	3	-	4	20	-	30	143	-	86	353	-	35	41
	4	-	-	30	-	-	275	-	-	671	-	-	41
	Total	2	24	79	2	132	640	15	547	1698	13	24	38
1986	1	-	-	37	-	-	405	-	-	1117	-	-	36
	2	5	18	13	10	141	147	97	492	264	10	29	56
	3 ¹	-	7	6	-	62	55	-	104	131	-	60	42
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	5	25	56	10	204	607	97	596	1512	10	34	40

¹Through 25 August 1986.

Appendix 6. Commercial surf clam catch and effort statistics for the Georges Bank assessment area, 1984-1986. Data are presented by calendar quarter for each of three vessel size classes (see text), and were derived from vessel trip logbook reports.

Year-Quarter	Number of Trips Analyzed Vessel Class			Total Catch (Hundreds of Bushels) Vessel Class			Total Hours Fished Vessel Class			Mean Bushels/Hour Vessel Class			
	1	2	3	1	2	3	1	2	3	1	2	3	
1984	1	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	3	38	-	28	750	-	33	282	-	85	266
	3	-	12	137	-	109	1948	-	205	1751	-	53	111
	4	-	-	3	-	-	66	-	-	30	-	-	220
	Total	-	15	178	-	137	2764	-	238	2063	-	58	134
1985	1	-	-	1	-	-	3	-	-	30	-	-	11
	2	-	8	119	-	39	1479	-	89	1925	-	44	91
	3	-	12	70	-	116	1135	-	136	1032	-	85	110
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	20	190	-	155	2617	-	225	2987	-	69	88
1986	1	-	-	5	-	-	169	-	-	108	-	-	156
	2	-	18	42	-	222	836	-	147	512	-	151	163
	3 ¹	-	8	33	-	109	478	-	52	326	-	210	146
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	26	80	-	331	1483	-	199	946	-	166	157

¹Through 25 August 1986.